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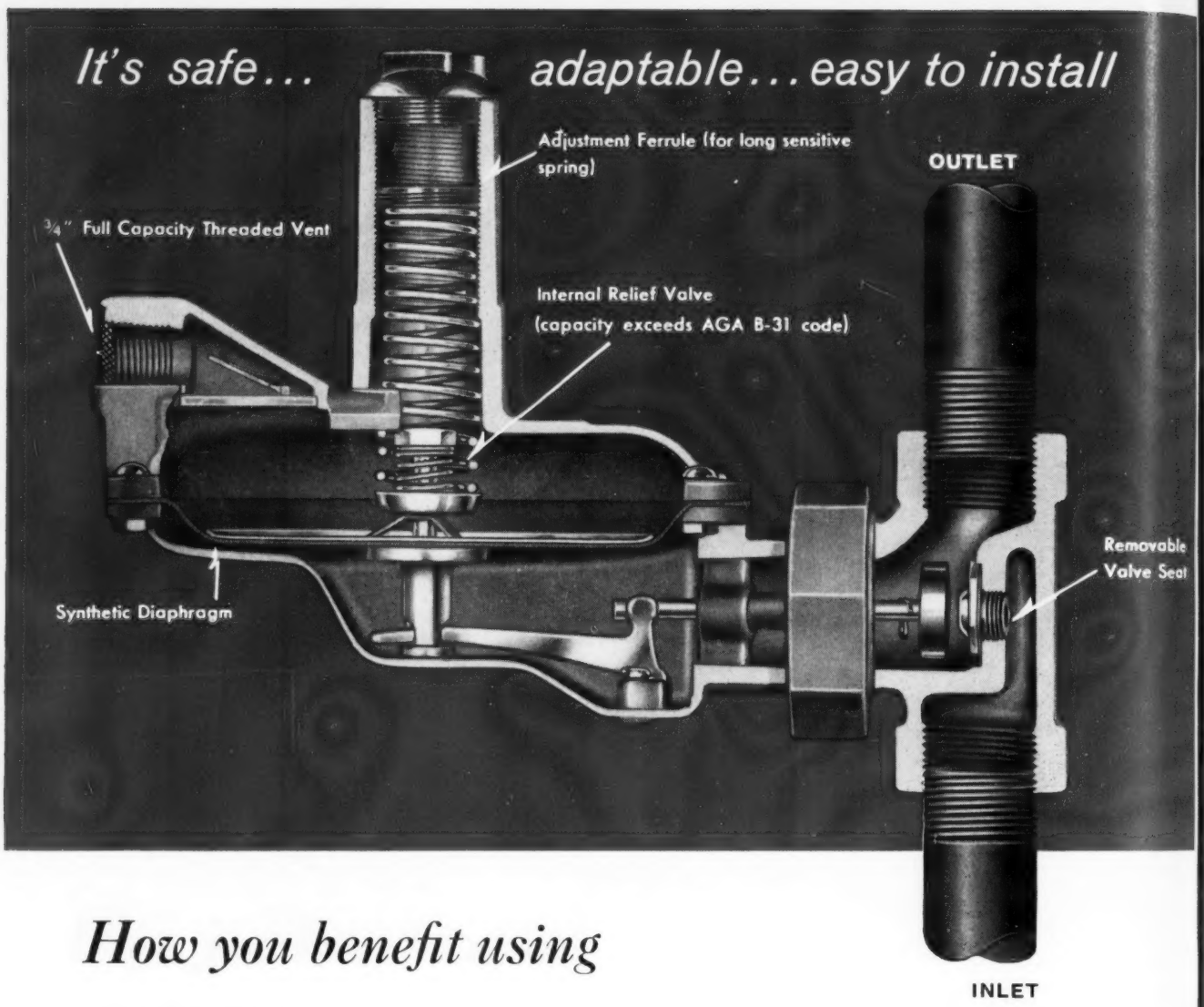

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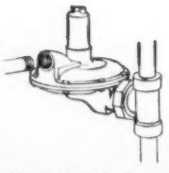
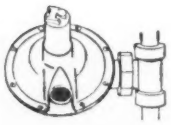
INDOORS 

OUTDOORS 

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ONLY MAGAZINE EDITED EXCLUSIVELY FOR THE GAS DISTRIBUTION INDUSTRY

Volume 187 **July 1960** **Number 7**

PILOT.. ..LIGHTS

Bubbles and Barriers

A revolution in the underground natural gas storage business is taking shape south of Chicago these days. Engineers and geologists with Northern Illinois Gas Company have punched a series of holes into the earth's interior, piercing below a hard cap rock lid into a spongy sandstone, readying themselves for a unique experiment. Water injected into a ring of wells is expected to create a wall of water beneath the cap rock to form a container. In the center, air is being injected (in place of expensive gas), to form a big "bubble" that may prove a forerunner for a new idea in underground storage. If the idea works—and there's little reason to doubt it will—gas utilities everywhere will be able to utilize now-unusable three-sided "domes" and "flat cap rocks" for storage purposes . . . especially where natural dome formations don't exist.

Do Small Cars = Big Savings?

Yes, say some utilities. Maybe, say others. And a few flatly don't believe they can effect much economy by switching from "standard" automobiles to the new compact cars. On page 20 is a report of a panel session devoted to the subject, presented at the A.G.A. Distribution Conference in New Orleans.

What's New . . .

. . . in two-way mobile radio? Transistorized units, that's what! One company's experience to date and why they like 'em is presented on page 30.

. . . in porous-medium burners? Plenty . . . and research is underway at the Institute of Gas Technology to make them an even more valuable ally of the gas industry. Complete report begins on page 23.

Handbook Time Again

Off and running in August will be the 1960 edition of *American Gas Journal's* GAS HANDBOOK ISSUE. Many sections will be completely revised, and considerable new data added. As usual, AGJ's editors have worked closely with top industry authorities to keep the HANDBOOK's data current and timely. Every regular AGJ subscriber receives the HANDBOOK at no extra cost . . . and it's not sold separately.

IN THIS ISSUE . . .

MANAGEMENT & OPERATIONS

"Bubble" Method May Revolutionize Gas Storage 17

Northern Illinois Gas engineers are experimenting with a revolutionary method of storing gas underground using a connecting wall of water beneath a flat cap rock.

Compact Car Report: How Good Are They? 20

Five major gas utilities reveal how compact cars they had "under test" compare with standard models on gas mileage, repair and maintenance, and initial costs.

Transistorized Two-Way Mobile Radio Units 30

Easy to install, compact enough to go under the front seat, and low — 10 percent lower — maintenance costs are three reasons why South Jersey Gas Company votes for transistorized mobile 2-way radios.

LOAD BUILDING

New Studies of Porous-Medium Burners 23

Special IGT report discusses latest developments in porous medium burners and their applications in modern heat processing.

The "Store" That Goes To The Customer 19

Oklahoma Natural Gas' mobile gas appliance display is touring approximately 70 cities and towns in ONG's service area . . . with good results.

CONSTRUCTION

Control of Contract Construction 27

Adequate, clearly worded contracts and specifications, methods of bidding and inspection are cited as effective controls of construction by contractors.

Distribution Developments 35

News about current and planned construction activities of distribution companies.

FEATURES & DEPARTMENTS

MCF — News Hilites: *California studies "rising natural gas rates," seeks to create "public concern" over the issue* 3

Gas Distribution Industry News: *Phillips' new plastic pipe welding technique holds promise* 7

Men At Work: *News about industry promotions, retirements, changes* . . 10

Coming Events in the Gas Distribution Industry 16

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Product Parade: *40 "ideas" to make your work easier, more efficient* 40

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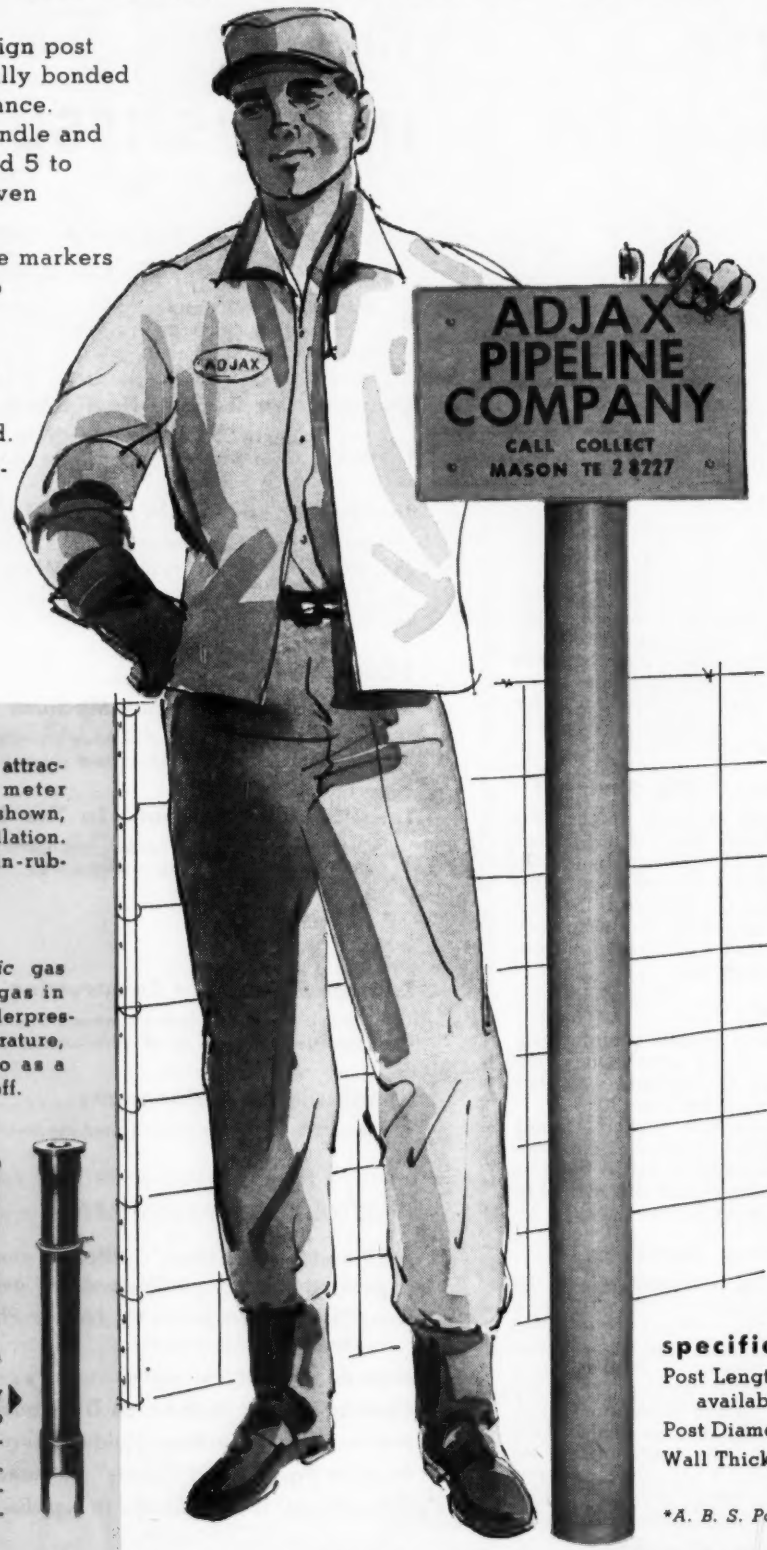

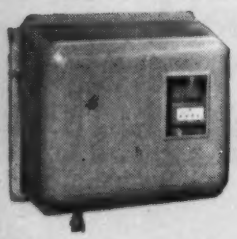

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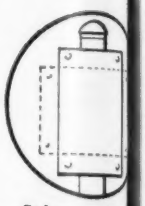
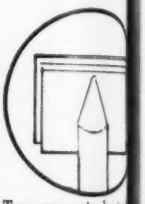


Side-mounted
(vertical or horiz
Front view shown



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sign post (vertic
horizontal). *Reac*
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with cap

Marker Post w
vent cap

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NEWS HILITES OF THE INDUSTRY

"Just and reasonable prices" for natural gas used in California was the theme of a conference called for late June by the California Public Utilities Commission. Topping the list of conferees at the Los Angeles meeting was William R. Connole (former FPCommissioner who was not reappointed by President Eisenhower) a champion of a "national fuels policy," and frequently referred to as "the voice of the consumer on the FPC" by other politicians. California Governor Edmund G. Brown said the conference was called to discuss two gas rate increases totaling nearly $47,000,000, in effect since 1958 and 1959 and being collected under bond without a final hearing by the FPC. Another rate increase, totaling over $22,000,000 annually is slated to become effective this August. PUC chief counsel William M. Bennett said the conference was called to "promote a public concern and awareness of the problem" of rising natural gas rates.

Perfumed water guns may become standard equipment for meter readers bothered by dogs that have a tendency to gnaw on the meter readers' anatomy. Down in Pineville, Louisiana, meter readers for Central Louisiana Electric Company are being equipped with water guns filled with perfume . . . on an experimental basis, of course. W. R. Crooks, CLECO safety director, said the guns will provide protection to both man and dog. The smell of perfume is said to make the animal lose all interest in biting the victim . . . and it doesn't harm the dog.

Natural gas service to more than 300 communities in the upper Midwest, dependent upon gas supplies available from Northern Natural Gas Company as result of an FPC approval last July to that company's application to provide such service, received a green light from the District Court of Appeals in Washington, D. C. The court in mid-May upheld the FPC action and turned down an appeal by Minneapolis Gas Company and the Metropolitan Utilities District of Omaha, who claimed the new lines would place an undue financial burden upon them. Service to a number of communities under the approval was contingent upon contributions from the cities, which otherwise would not be justified. Further court action is possible, though, as the complainants can still appeal to the Supreme Court.

New storage field to serve customers of Laclede Gas Company in the greater St. Louis area and customers of Illinois Power Company has been proposed by a new company, Mississippi River Transmission Corporation. The St. Jacobs storage field, located in Madison and St. Clair counties in Illinois, is about 20 miles east of St. Louis. Gas for the field would be supplied by MRT, a subsidiary of Mississippi River Fuel Corporation, which would purchase 50,000,000 cu ft per day from Trunkline Gas Company near Johnsonville, Illinois, and transport it through a 90-mile, 18-in. line to St. Louis. The line would cut across the St. Jacobs storage field. The field itself would be developed and operated by Laclede, MRT, and Illinois Power. Laclede would own 64 percent, Illinois Power—11 percent, and MRT—25 percent. Application for building and operating the new facilities has been filed with the FPC. Storage output potential of the field is estimated at about 40,000,000 cu ft per day by 1963.

Colorado's Supreme Court has ruled that the state cannot regulate prices in direct industrial gas sales by Colorado Interstate Gas Company. In a 4-to-2 decision, the court ordered the Colorado PUC to vacate a directive requiring the gas company to show cause why it should not be regulated.

Ultrasonic device for non-destructive testing of steel pipe may be ready for use by year's end, with a prototype model scheduled for testing operations at pipe mills. The device—a laboratory version—was unveiled at the A.G.A. Operating Section Conference in New Orleans. Development was result of intensive research program by Southern Gas Association and A.G.A.

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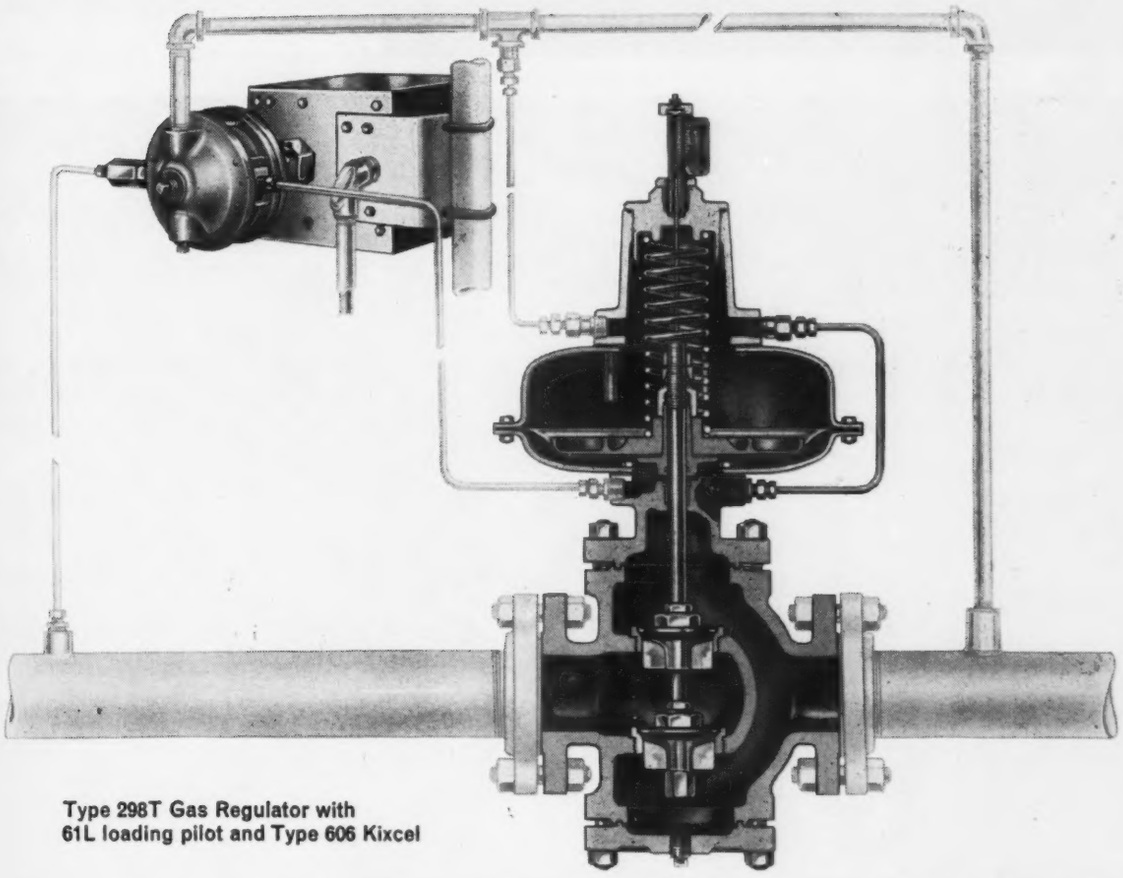

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NEWSREEL

Magnetohydrodynamics — Latest breakthrough is Westinghouse Electric Corporation's electrical generator capable of producing up to 10 kw of power by passing a hot, ionized gas stream through a magnetic field. Though still a tongue tripper for most engineers, magnetohydrodynamics (MHD), is no longer an unfamiliar word. In less than six months, at least 3 electrical power generators based on this principle have made news — General Electric, late in 1959 announced a lab-scale MHD device capable of producing 1000 watt of power in 5-sec bursts. Shortly later, Avco Corporation disclosed, that with aid of 10 electric utilities, it had developed an 11,000-w generator and was planning a 100,000-w version for the near future. Though differing in details, all 3 devices convert thermal energy to mechanical energy to electrical energy according to a technique first described by Faraday over a 100 years ago. GE uses a 5000 F ionized air plasma; Avco uses an ionized argon plasma at temperatures in excess of 4000 F. Westinghouse has succeeded in harnessing combustion products of furnace oil and oxygen. To get the needed ionized condition, the company "seeds" the 4600 F gas stream with easily ionized potassium soap.

Plug-in gas appliances — West German engineers have developed a way to plug in a gas appliance cord to an outlet like an electric one. It consists of a white hose that connects to the appliance, at the other end of which is a plug that fits into a gas outlet. A slight turn of the plug to the left opens and a twist to the right turns off the gas.

Plastic pipe welding — butt fusion. Leo Croley of Phillips Petroleum Co., Bartlesville, at a recent Permian Basin Regional meeting of the National Gasoline Association of America, described a newly-developed method of butt-fusion joining of plastic pipe that is simple, fast, cheap, and gives a strong joint. Phillips has developed semi-automatic equipment that eliminates much of the hand labor involved in welding plastic pipe. One unit joins 2, 3, and 4 in.; a larger unit handles 2, 4, 6, and 8-in. sizes. Equipment provides line-up clamps; portable generator provides electrical power for the inline facer and heating plant. Simply, the squared pipe ends are pressed against an electrically heated aluminum plate at 380-410 F. Pipe ends are kept against the plate until a 1/16-in. diam bead forms and rolls back from the plate. Then, pipe ends are pulled away, plate removed, and the ends gently pressed together. After ½ min of cooling (4 to 6-in. diam) the pipe joint is ready for service — stronger than the plastic pipe itself.

Newest Russian claim is development of a semiautomatic welding unit and a fully automatic twin-arc unit for carbon-dioxide-shielded arc welding of pipe joints in fixed (without rotation) position without backing rings. Both units were described in the May issue of *Svarochnoye proizvodstvo* as being developed by the E. O. Paton Institute of Electric Welding of the Ukrainian Soviet Socialist Republic's Academy of Sciences, and the All-Union Scientific Research Institute of Pipeline Building. The units, the article noted, were tested during construction of the Shebelinka to Belgorod gas line.

Worth Reading . . .

What may be the most comprehensive analysis of federal regulation of natural gas producers is presented in a new University of Oklahoma Press book, **The Natural Gas Industry: Monopoly and Competition in Field Markets** by Edward J. Neuner. Author Neuner, a PhD from Columbia University and assistant professor of economics in San Diego State College, investigates whether or not monopoly conditions necessitating public price-fixing actually exist in natural gas production. *"As far as the facts and analyses of this study have been able to show, the requisite condition of monopoly is difficult to find. It is not that the investigation has been unable to discover any element of market power, or that regulatory intervention of any kind is unnecessary. Rather, it is a case where the degree of market power on the seller side of the field market simply does not appear great enough to warrant the application of public price controls. If field price regulation — on a utility cost standard or otherwise is to be sanctioned, it must be founded on something besides a claim of monopoly behavior or excessive concentration among gas producers."*

Neuner develops factual data, provides an analytical framework for weighing these data, and utilizes both in a careful evaluation of monopolistic influences in the natural gas field markets. He investigates the nature of the market power available to gas producers, and the monopolistic potential of certain field market practices — long-term purchase contracts, favored-nation clauses, price redetermination provisions, spiral escalator clauses, tax sharing, and inflation adjustment — and summarizes that *"the strongest monopolistic influence in the gas field stem from the possibility that a few sellers may increasingly dominate remaining uncommitted gas reserves"* . . . a condition literally being fostered by today's lengthy, costly, red-tape FPC procedure of controlling independent gas producers.

How Steel and Polyethylene Compare: $/Ft for 3-In. Pipe.

	Pipe Cost	Install, Including Weld	Install, Excluding Weld	Weld	Coat	Cathodic Protection	Total Installed Costs
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0.125-in. wall	0.54	0.25	....	....	0.05	0.05	0.89
0.134-in. wall	0.59	0.25	....	....	0.05	0.05	0.94
0.141-in. wall	0.65	0.25	....	....	0.05	0.05	1.00
0.156-in. wall	0.66	0.25	....	....	0.05	0.05	1.01
Sch 40	0.76	0.25	....	....	0.05	0.05	1.11
High-Density Polyethylene, Sch. 40	0.69	....	0.13	0.02	....	....	0.84

*Does not include engineering overhead (right-of-way, survey, etc.).

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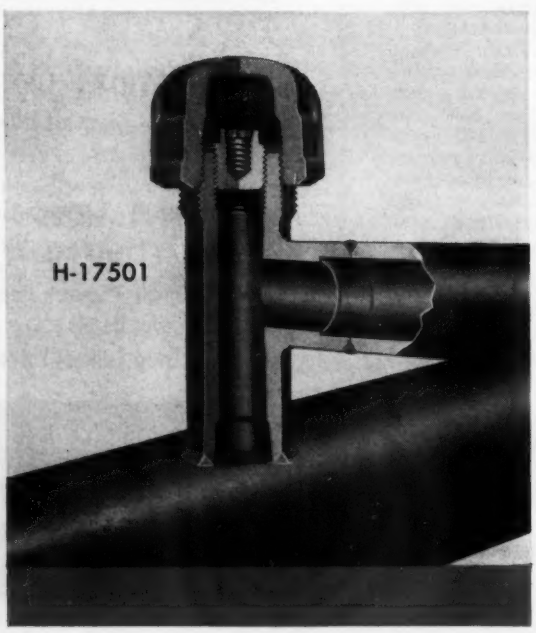

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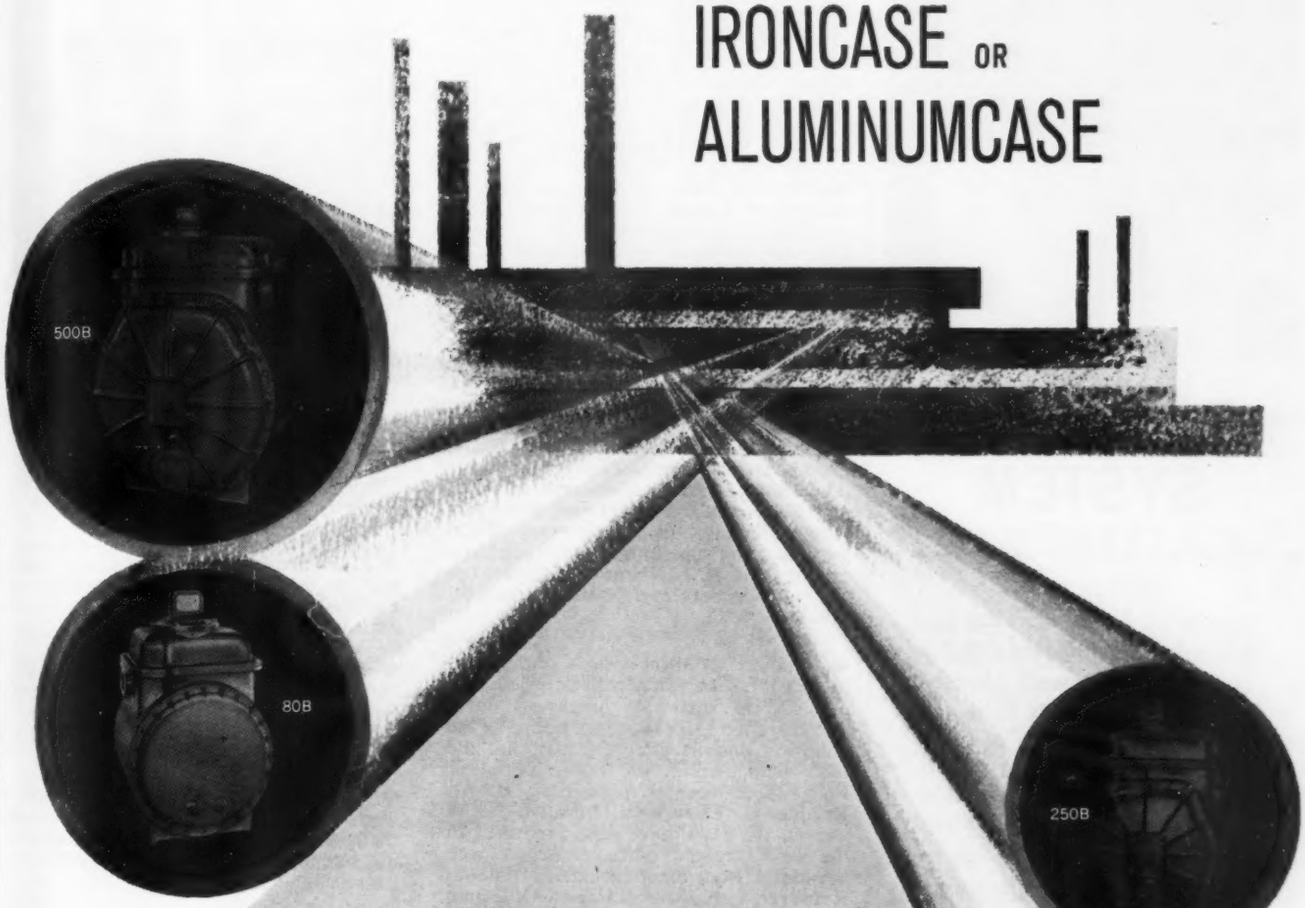

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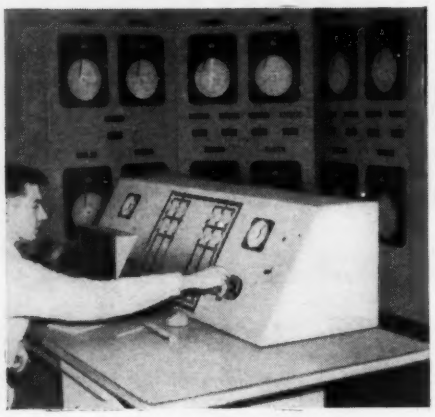

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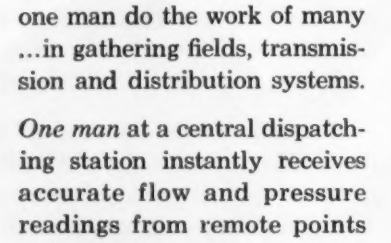

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MEN AT WORK

IN THE GAS DISTRIBUTION INDUSTRY

● **Harold W. Johnston,** chief engineer of The Gas Service Co., has been elected to the board of directors in a series of promotions involving six company employees: **Charles H. Rambo,** assistant general superintendent, has been named assistant chief engineer. **Alvin C. Singer,** construction and maintenance department superintendent in the Kansas City, Missouri, division, will be a new assistant engineer in the general office operating department. **Vernon Eugene "Gene" Percell,** superintendent in the Kansas City, Kansas, division, succeeds Singer as superintendent of Kansas City, Missouri, construction and maintenance department. **Clarence Balwanz,** superintendent in St. Joseph returns to Kansas City, Kansas, as superintendent succeeding Percell. **Max F. Williamson,** engineer at Wichita, succeeds Balwanz as superintendent in St. Joseph.

● San Diego Gas & Electric Co. has announced the following personnel changes: **Lloyd M. Wall** to district office director; **Kenneth M. Brown,** to district manager, eastern district; **Otis L. Pemberton,** to district manager, Chula Vista district; **Richard E. Farwell,** to district manager, Orange County district. **Howard Wylie** moves up to superintendent, district operation, and **R. L. Tilford** to district operating supervisor in the eastern operating district.

● Southern Natural Gas Co. has announced that **C. van den Berg,** vice chairman of the board of directors, retires July 31 after 33 years of service with the company and its affiliates, and that the office held by him will be discontinued. Four company vice presidents, **H. M. Erskine, H. E. Jackson, John M. Starke** and **O. W. Clark** have been promoted to the newly-created office of senior vice presidents. Four other executives, **William S. Tarver, L. N. Brown, Robert G. Kenan** and **Mortimer Jordan** have been elected vice presidents. **Howard Maxton** was also elected an assistant treasurer.

● Sprague Meter Co. has announced the appointment of **Howard R. Peirce** as Midwestern regional sales manager. He has formerly been assistant division manager.

● Southern Cross Foresters' has announced two promotions: **Mayes Pierce** has been named operations manager of the Atlanta-based firm, and **William T. Barnett, Jr.,** has been appointed regional representative with headquarters in Dallas.

Deaths

Edward O. Werba, chief engineer, Atlanta Gas Light Co.

George H. Neilson, vice president of Algonquin Gas Transmission Co. and former general superintendent of Equitable Gas Co. of Pittsburgh before joining Algonquin.

Raymond H. Lewis, 52, general sales manager for the Buflovak equipment division of Blaw-Knox Co.

R. E. Brooks, 77, a pioneer in establishing the packaged boiler industry, and chairman of the board of Cleaver-Brooks Co.

● **Alfred H. Doud** has been appointed director of public relations of the Rochester Gas and Electric Corp. He was formerly associate director of public relations.

A. H. Doud

A. G. Prasil

● **A. G. Prasil** has been named chief engineer for Southern Union Gas Co. of Dallas.

● Southern Gas Association has appointed **Roger H. Reid** assistant managing director. Reid was formerly with the U. S. Junior Chamber of Commerce of Tulsa, Oklahoma.

● **J. P. Stephens,** assistant to the manager of the gas operating department of Cincinnati Gas and Electric Co., retired effective May 1.

● **Virgil A. Brecheen,** assistant manager of Pioneer Natural Gas Co.'s Lubbock distribution office, has been named assistant tax commissioner in Pioneer's general office at Amarillo.

● **H. Whitcomb Nicolson,** assistant to the vice president in charge of gas operation of Public Service Electric and Gas Co., has retired on pension after 41 years service with Public Service.

● City Gas Co. of Florida re-elected **S. F. Danels,** chairman of the board, at its annual meeting. Other officers re-elected included: **S. W. Langer,** president and director; **M. Langer,** senior vice president, treasurer, and director; **J. T. Self,** executive vice president, assistant secretary, and assistant treasurer; **Harry Blumin,** vice president, secretary, and director; **Charles S. Roberts** and **Alexander Blumenthal,** vice presidents; and **Sidney Weiner, Jack Weiner, David Langer** and **Henry Harris,** assistant vice presidents.

● **William B. Padon** of Tulsa has been elected vice president in charge of administrative affairs for Transwestern Pipeline Co. of Houston. His resignation as a vice president and director of Warren Petroleum Corp. has been accepted by that corporation so he can assume new full-time duties with Transwestern. The pipeline company is owned jointly by Warren, J. R. Butler and Associates of Houston, and Monterey Oil Co. of Los Angeles.

● Recent personnel changes at Ohio Fuel Gas Co. include: Promotion of **Robert D. Clevenger** to junior engineer in the Mansfield district office; retirement of **Virgil J. Butts,** heating and air conditioning specialist, and the appointments of **Albert A. Sandberg** as Columbus district air conditioning specialist, and **Norman R. Millard, Jr.** as Columbus district gas advisor.

● **Theodore I. Gradin,** assistant director of the A.G.A.'s Bureau of Statistics for the past two years, has been named director of the Bureau. He succeeds **Daniel Parson,** who joined Northern Illinois Gas Co. July 1 as company's first manager of rate and economic research.

T. I. Gradin

F. W. Batten

● **Fred W. Batten** has been elected vice president and chief operations officer of The Columbia Gas System. He was formerly vice president of Columbia's Service Corp.

● **John H. Tyler,** former vice president of Norwood Gas Co., will move to Malden, Massachusetts, to become assistant to the president of the gas companies of the New England Electric System, succeeding the late Robert H. Patterson. **A. J. Fabiani** of Norwood will succeed Tyler as vice president and manager of Norwood Gas Co.

● **Chester S. Crawford** has been elected a director of American Meter Co. He is also president and a director of the Whitehall Cement Mfg. Co., a director of Interstate Railroad, and a director of the Portland Cement Association.

● The Frank Wheatley Corp. has named **J. S. Tayrien** head of valve sales in the Permian Basin, Odessa, Texas. **Ken Sutton** has been named special sales representative for mechanical rubber goods and miscellaneous fittings in northeastern Oklahoma area.

● Superior Meter Division has appointed **Robert F. Benda** sales representative for gas meters and allied products in Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

● **Luke R. Lamb,** a supervisory trial attorney on the legal staff of the FPC since 1955, has been appointed to the position of assistant general counsel with the FPC succeeding **W. Russell Gorman,** who resigned April 30 to enter private law practice in Washington.

● Three States Natural Gas Co. has named **William H. Hudson** president succeeding **John A. McGuire,** who moves up to the new post of board chairman.

● **William H. Brittain** of Montreal, Canada, has been promoted to supervisor of Canadian activities for Heath Survey Consultants, Ltd. He was formerly senior consultant at Heath.

● **Hugh Jacobson** has been appointed manager, systems sales, at the Burbank branch of Librascope Division, General Precision, Inc. and will direct national sales of Litratrol process control systems produced by the branch and marketed through its industrial systems department.

● **Ken Kane** has been appointed natural gas superintendent of the Saskatchewan Power Corporation's Grenfell office. He will be in charge of gas distribution services at Grenfell, Wolseley, Broadview, Indian Head, Qu'Appelle, Fort Qu'Appelle, and Balcarres where gas systems will be built during the current construction season.

● **George W. Anders,** former director of public relations for Texas Gas Transmission Corp., has been appointed to the newly-created office of director of financial relations. Succeeding Anders as director of public relations is **John R. Blewer,** who was formerly manager of financial relations with Bozell & Jacobs, Inc., public relations and advertising counsel to Texas Gas.

● **Ransom M. Cook** has been elected a director of the Pacific Gas and Electric Co., succeeding the late Harry C. Kirk. Cook is president and chief executive officer of Wells Fargo Bank American Trust Co.

● **F. J. Schneider** has been elected vice president in charge of operations for Niagara Mohawk Power Corp. succeeding J. Leo Welch, who died February 10. Formerly superintendent of operations for the company's western division at Buffalo, Schneider will direct all electric and gas operation of Niagara Mohawk system from headquarters at Syracuse.

● Series of management promotions in Southern Counties Gas Co.'s general office headquarters in Los Angeles has been announced: **D. E. Shively,** supervisor of stores in the purchases and stores department, has been named administrative specialist in the customers department, charged with evaluating latest developments in business equipment and processes that may be used in the utility's operations. **R. H. Watson,** formerly staff assistant in accounting department who has been filling a temporary assignment in company's Orange County division, has been named staff supervisor. **J. R. Leman** has been promoted to post of staff supervisor in the customers department. **M. P. Walker,** previously general storekeeper, succeeds Shively as supervisor of stores.

D. E. Shively

T. M. Isaacs

● Robertshaw-Fulton Controls Co. has appointed **Thomas M. Isaacs** director of advertising and sales promotion. Formerly, Isaacs was program supervisor of industrial advertising for Reynolds Metals Co. **Beverley L. Britton** has been appointed director of public relations for Robertshaw-Fulton with offices at the firm's headquarters at Richmond, Virginia. He was formerly manager of the news bureau of the Baltimore, Maryland, division of The Martin Co. Also announced, was the election of **D. Rex Scott,** former general manager of the company's Western Research Center at Anaheim, California, to the position of assistant vice president.

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W-250	Rated cap. 250cfh — FOB Philadelphia
W-300	Rated cap. 300cfh — FOB Philadelphia
W-45-LPG	Rated cap. 45cfh* — FOB Philadelphia
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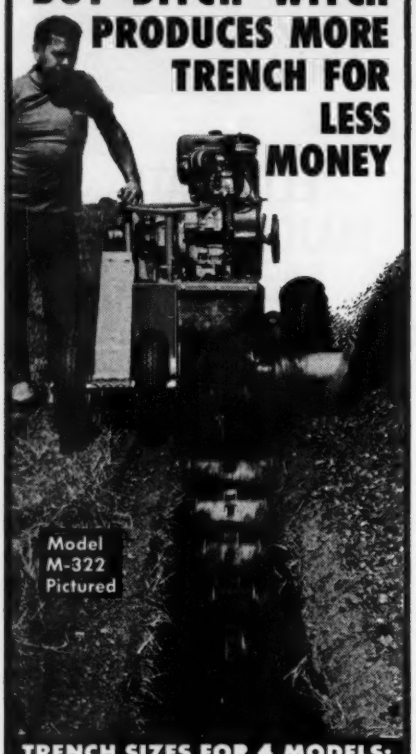

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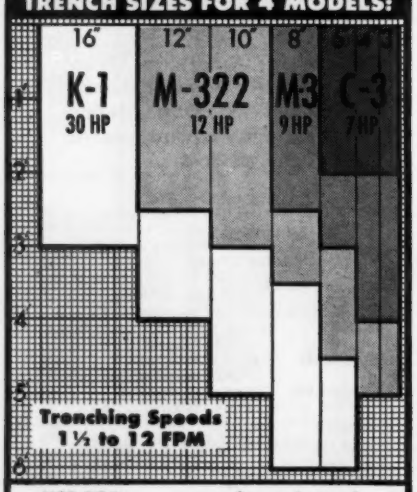

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Men at Work

● North Shore Gas Co. (Waukegan, Illinois) has announced the appointment of **Anthony J. Demse,** a registered professional engineer, as assistant to the president.

● **Walter C. Schmidt** has been elected a vice president of Consumers Power Co. Formerly manager of engineering and construction, he will also be in charge of purchasing and stores. **Robert D. Allen** has been elected assistant to the president; he was formerly co-ordinator of consulting engineering services.

● **Norman B. Bertolette** has retired as chairman of the board of The Hartford Gas Co., but will continue his interest in the company as a member of the board of directors of which he is chairman of the executive committee.

● Northern Indiana Public Service Co. has announced a series of promotions in its newly-created northeastern division: **James D. Breed,** manager of NIPSCO's all-gas Elkhart district, has been promoted to manager of the combination (gas and electric) Goshen district succeeding **W. Dean Shannahan,** who has retired. **Jack W. Stine,** manager in Columbia City, has been appointed manager of the Elkhart district, succeeding Breed. **Paul E. Seybert,** now division supervisor of industrial power sales in the Michigan City division has been appointed manager of the South Bend district, succeeding **Daniel O. Kreitzman,** who now heads the newly-created northeastern division.

● Pioneer Gathering System, Inc. wholly-owned subsidiary of Pioneer Natural Gas Co., has elected four new officers: **James A. Davis,** Pioneer Natural Gas vice president in charge of gas supply operations, has been elected president and general manager of the subsidiary company. He has also been named a member of Pioneer Gathering's board of directors replacing **A. F. (Art) Cox,** who has resigned. Cox is president of Amarillo Oil Co., another Pioneer Natural Gas subsidiary, and a member of Pioneer Natural's board of directors. **B. P. Smith,** who resigned as president of Pioneer Gathering System, has been named vice president of that company. **W. A. (Bill) Paxton** has been named treasurer of Pioneer Gathering System, and **Jack Gholson** has been named assistant treasurer. Paxton is manager of corporate taxes for Pioneer Natural and Gholson is assistant manager of corporate taxes.

● **J. Paul Leinroth,** manager industrial and commercial sales for Public Service Electric and Gas Co., has retired after more than 38 years' service. He started with Public Service in 1922 as general industrial fuel representative, where he was responsible for the promotion of gas for industrial, commercial, and building heating purposes.

● Equitable Gas Co. has expanded its sales program in the commercial and industrial fields by naming **M. A. Washabaugh** and **V. A. Woodward** supervisors. Washabaugh will be responsible for supervising load building activities and establishment of service to all commercial and industrial customers. Woodward will be responsible for contacting architects and consulting engineers.

● Promotion of **Malcolm M. Bridgwater,** vice president, to manager of Arizona Public Service Co.'s new power contracts and scheduling department, has resulted in the promotion of **Max R. Llewellyn** to the post of manager of gas and electric operation formerly held by Bridgwater.

● **Andrew W. Johnston** and **Claude F. Machen** have been elected directors of Boston Gas Co. Johnston is vice president in charge of gas operations and Machen, a vice president, directing administrative services, personnel, and the company's Charlestown electric division.

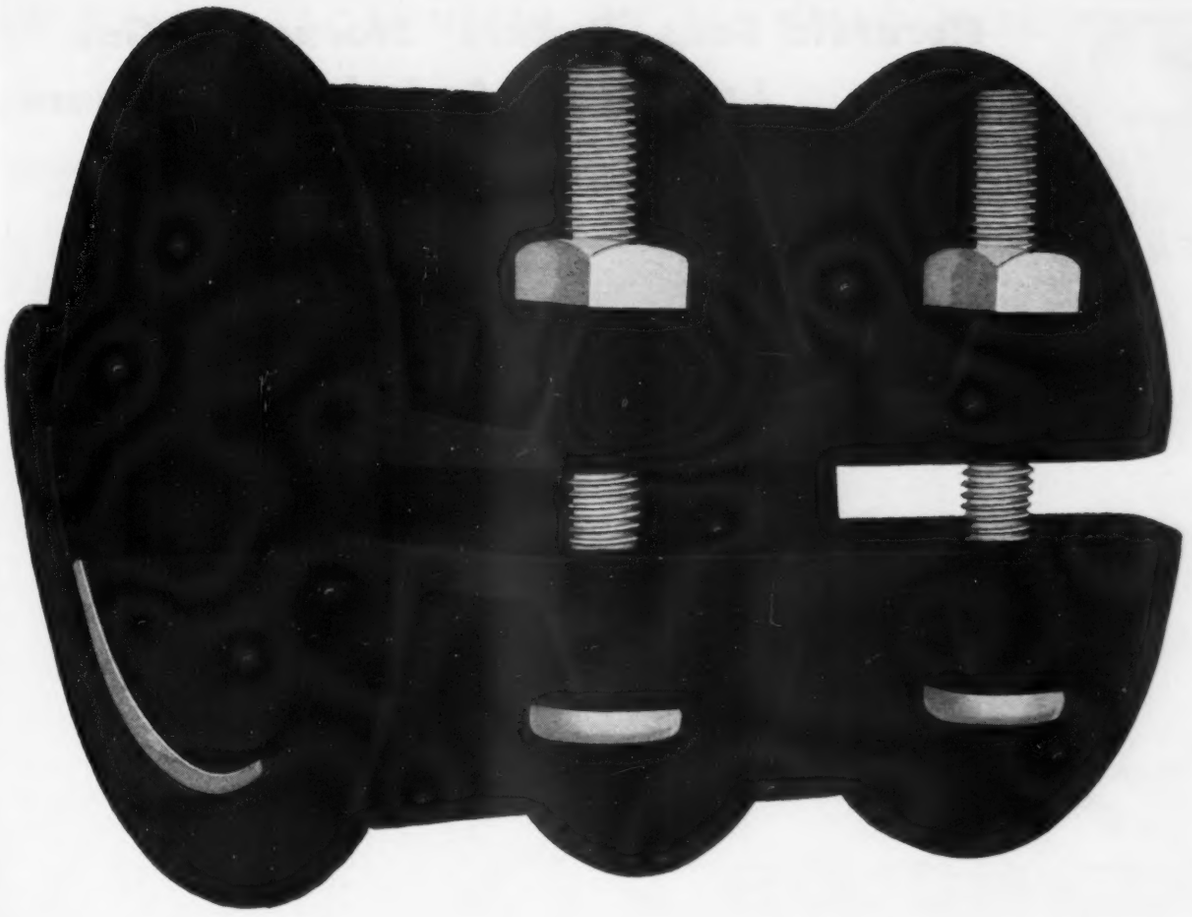
● **Martin Kirk Hager** has been appointed to the gas procurement staff of Columbia Gas System Service Corp. at Houston, Texas. He was previously with Panhandle Eastern Pipeline Co.

● Commonwealth Natural Gas Corp. has elected 4 new vice presidents: **Chester E. Starkey,** assistant secretary and assistant treasurer from 1951 to 1957 and subsequently assistant to the president; **Osmond T. Jamerson,** director of public relations; **Paul H. Riley,** measurement superintendent from 1952 to 1958 and later superintendent of measurement and dispatching, moves up to vice president and chief engineer; and **Harvey S. German,** superintendent of pipelines and construction, becomes vice president, maintenance and construction.

● East Ohio Gas Co. has announced two changes in its sales department. **Robert A. Modlin,** industrial sales manager since 1958, has been promoted to assistant general sales manager, and **William H. Harper, Jr.,** has joined the organization as sales promotion manager.

● Iowa-Illinois Gas and Electric Co. has announced the following personnel changes: **Edward Paper,** customer service, has been made service superintendent for the Quad Cities. **Clarence "Deke" Trout,** customer service, has assumed the duties of builder coordinator. **Harold "Howie" Hansen,** customer service, Davenport district, has been made field supervisor, and **Joseph Peterson,** customer service, Illinois district, has been named field supervisor.

"Lines under the house are all OK, Ed."



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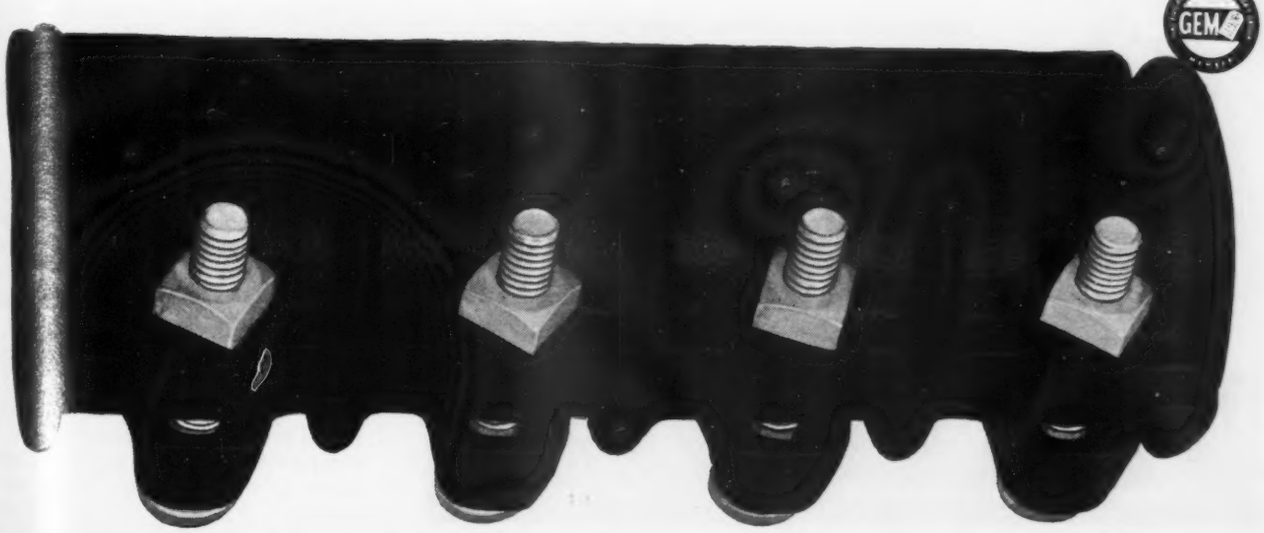


Kornfeld Sees "Bubble" Storage of Gas In Aquifers As Industry Advance . . .

J. A. Kornfeld
Consultant
Tulsa, Oklahoma

In an exclusive Dallas interview, Joseph A. Kornfeld, natural gas consultant of Tulsa and author of the current AMERICAN GAS JOURNAL five-part series on aquifer storage, believes the "bubble" storage method (see related story on page 17) deserves experimental study, both in field pilot work, and under simulated conditions in laboratory models employing *potentiometric* studies.

Further, he notes, the experiments should be conducted under the following prerequisites:

1. Artificial gas segregation under structural inclination;
2. Satisfactory lithology;
3. Impervious reservoir seals; and
4. Artificial plugging of water-injection wells.

Artificial Gas Segregation

Rather than attempt to utilize aquifers occurring under horizontal bedding, Kornfeld believes experimental work should commence with structures that would naturally permit *artificial gas segregation*. He believes that the most obvious type of structure, next to the anticline, would be the *terrace*. He suggests that case histories be reviewed throughout the world where natural-gas fields occur under *terrace structure* conditions. From these case histories geological studies can be reviewed to determine the character of the up-dip seal. In the selection of a terrace-type aquifer structure, the up-dip side of the aquifer can be sealed by a line of water-injection wells drilled to contain the artificial gas bubble.

Favorable Lithology

Unless the aquifer-bearing sandstones exhibit conditions of well-sorted fine-grained lithology and a good *vertical-horizontal permeability profile*, the danger of channeling might exist that would destroy the effectiveness of the project by preventing containment of the artificial gas bubble for injection-and-withdrawal gas service.

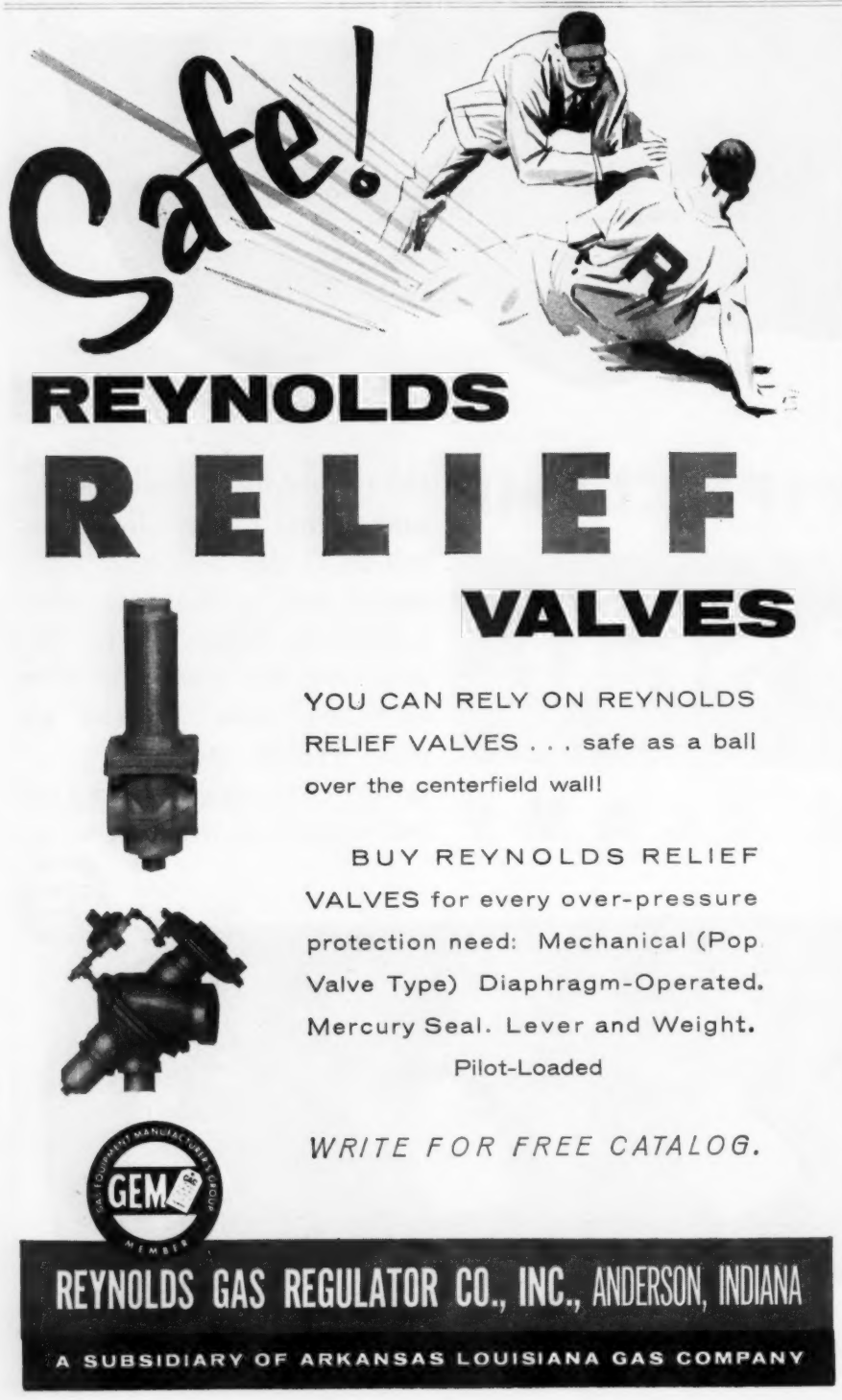
The absence of a native major *fracture system* in the aquifer would reduce the tendency toward channeling in actual practice.

Sealing Conditions

Existence of impervious formations both *above* and *below* the aquifer is an obvious necessary requirement to contain the artificial gas bubble within the confines of the aquifer.

Artificial Plugging

Provided the above conditions are met, the water-injection well could be used not only to provide *a permanent barrier* against gas movement and displacement, but the experiment should utilize injection conditions which would encourage *permanent plugging* of the area around the injection well through introduction of *incompatible injection water* under pH conditions which would prevent displacement of the incompatible injection water as compared to the properties of the native aquifer. * * *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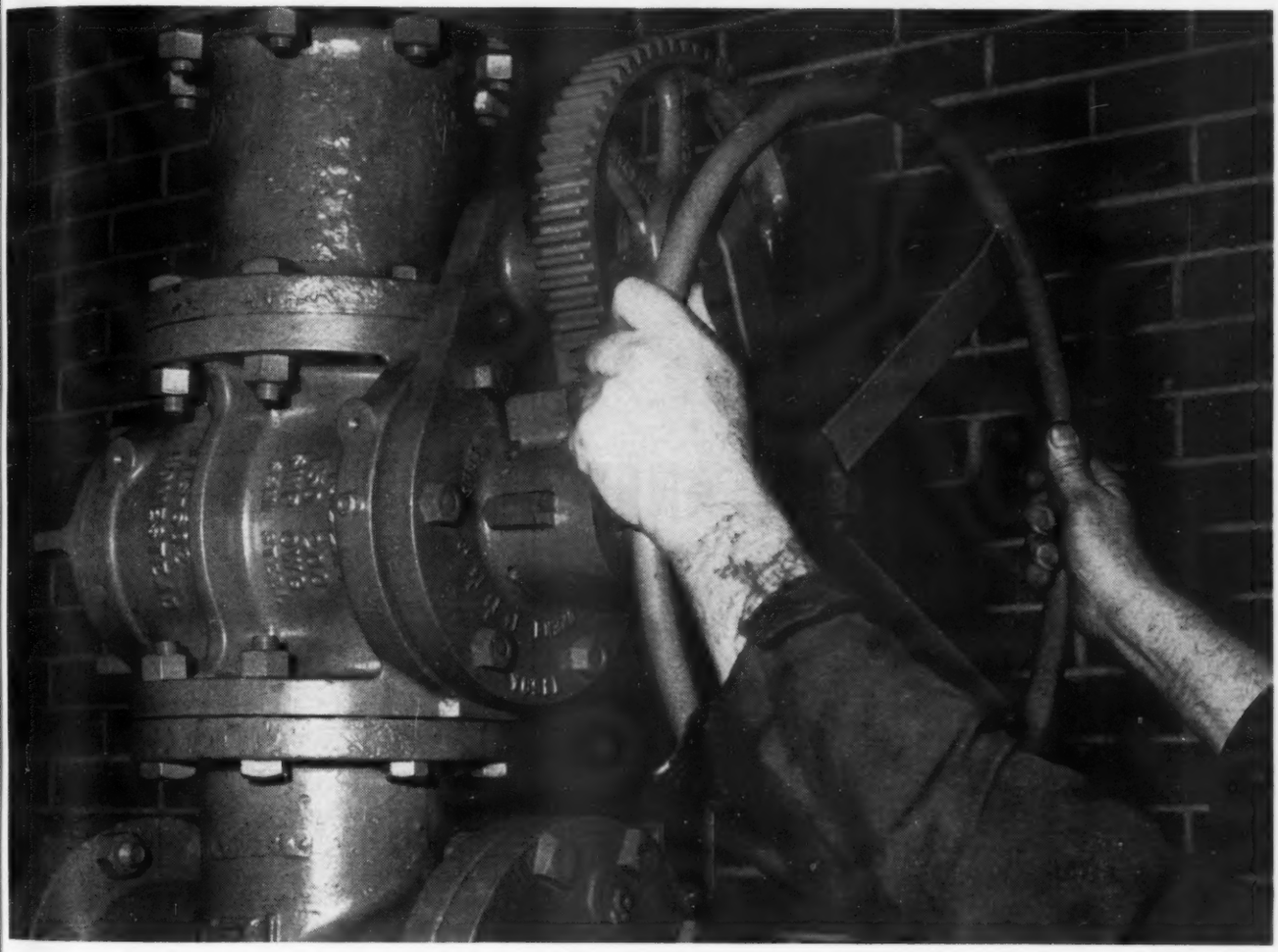

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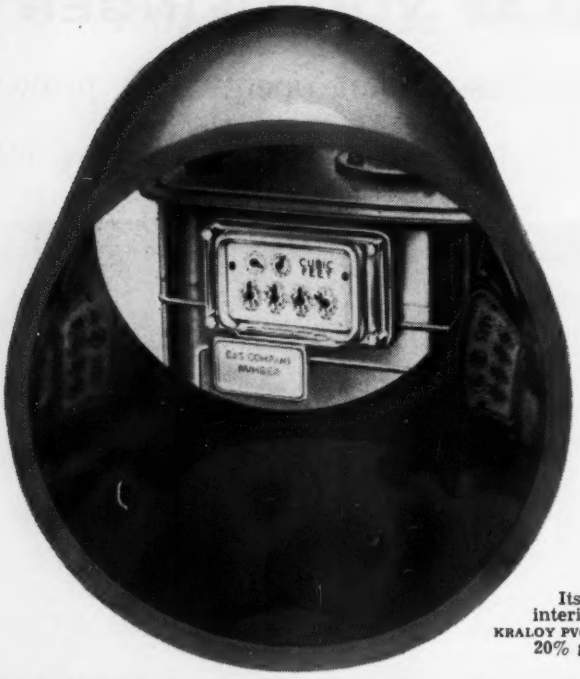

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COMING EVENTS IN THE GAS DISTRIBUTION INDUSTRY

July

24-Aug. 5 Ninth Annual Utility Management Workshop, Arden House, Harriman Campus, Columbia University, Harriman, New York.

August

17-19 Mid-West Gas Association gas school and conference, Iowa State College, Ames, Iowa.

29-31 Appalachian Gas Measurement Short Course, University of West Virginia, Morgantown, West Virginia.

September

9 New Jersey Gas Association, annual meeting (place to be determined).

12-14 A.G.A. accident prevention conference, Leamington Hotel, Minneapolis, Minnesota.

14-16 A.G.A. Operating Section Committee on Underground Storage, Statler Hilton, Buffalo, New York.

15-16 A.G.A. Textile Processing Symposium, Sedgefield Inn, Greensboro, North Carolina.

15-17 Public Utilities Association of the Virginias, 42nd annual meeting, The Greenbrier, White Sulphur Springs, West Virginia.

18-21 ASME Petroleum Mechanical Engineering Conference, Hotel Jung, New Orleans, Louisiana.

21-23 Southeastern Gas Association, annual meeting, Sir Walter Hotel, Raleigh, North Carolina.

21-23 PCGA annual meeting, Westward Ho Hotel, Phoenix, Arizona.

October

5- 7 Wisconsin Utilities Association, annual gas operating and sales convention, Schroeder Hotel, Milwaukee, Wisconsin.

6- 7 NACE western regional conference, Sheraton-Palace Hotel, San Francisco, California.

6- 8 NACE, southeast region conference, Dinkler-Plaza Hotel, Atlanta, Georgia.

10-12 A.G.A. annual convention, Atlantic City, New Jersey.

11-14 NACE, northeast region conference, Pritchard Hotel, Huntington, West Virginia.

17-21 National Safety Council, annual meeting, Chicago, Illinois.

19-20 NACE north central region conference, Schroeder Hotel, Milwaukee, Wisconsin.

21 NEGA commercial and industrial groups, Colonial Inn, Lynnfield, Massachusetts.

23-25 Independent Petroleum Association of America, annual meeting, Statler Hilton Hotel, Dallas, Texas.

26-27 1960 Computer Applications Symposium sponsored by Armour Research Foundation of Illinois Institute of Technology, Morrison Hotel, Chicago, Illinois.

November

14-16 American Petroleum Institute, annual meeting, Chicago, Illinois.

18-22 Air Conditioning and Refrigeration Institute annual meeting, Hollywood Beach, Florida.

27-Dec. 2 A.G.A. Gas Air Conditioning Sales School, Columbus, Ohio

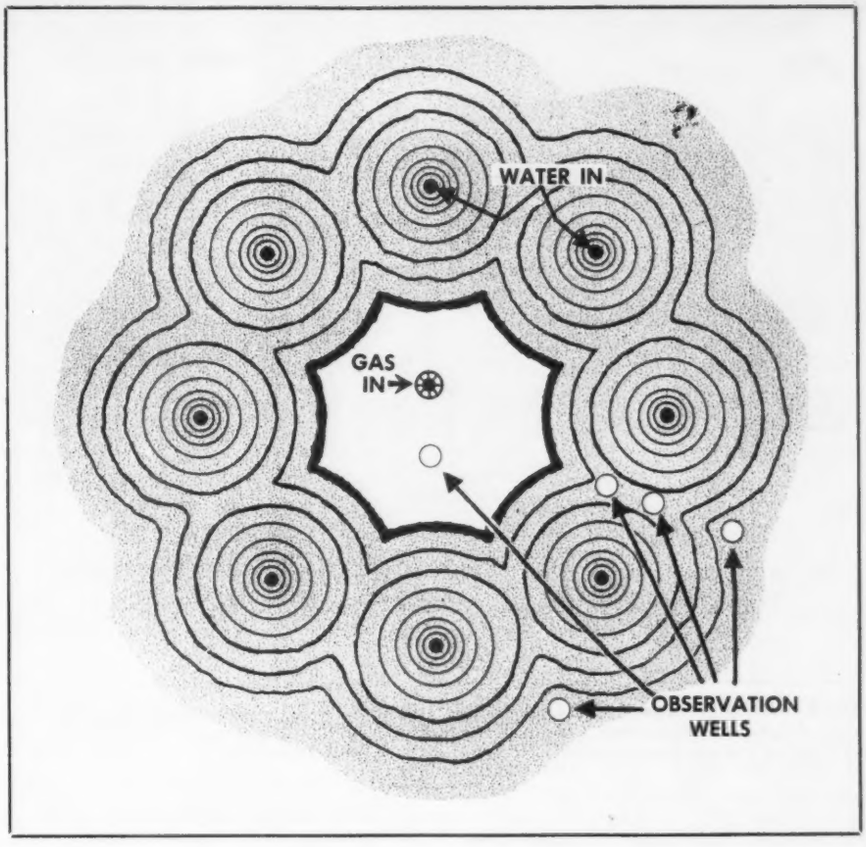


FIG. 1. Experimental storage "bubble" at NI-Gas' Station 147 is explained by diagram. Eight water injection wells have been drilled around a 1700 ft diameter circle. Water injected will connect to form a continuous "wall" as shown by the shaded area. Air (in place of gas) will be injected in the center of the area. Numerous observation wells will allow engineers to check the experiment's progress.

Northern Illinois Gas Company experiment uses wall of water to seal underground storage container topped by a flat cap rock

"Bubble" Method May Revolutionize Gas Storage

Dean Hale, *Editor*

A BUBBLE OF NATURAL GAS beneath a flat cap rock, surrounded by a wall of water, may be the method of the future for underground storage if a revolutionary experiment underway by Northern Illinois Gas Company proves successful.

Admittedly, the idea is still in the experimental stages, but engineers and geologists studying the method see no reason that it won't work under proper conditions.

What NI-Gas' engineers are doing seems quite simple: They've drilled eight water-injection wells in a circle around a gas-injection well. Into the wells on the periphery, they will inject enough water to form a connecting "wall" of water beneath the cap rock structure. This "wall of water" will provide a gas-tight seal that will completely enclose the "container" in the middle into which the gas can be injected.

In the experimental stage, the NI-Gas engineers are using air instead of gas, but the results will be the same. The air forced into the center of the container is expected to form a "bubble."

Why It Works

Several conditions are necessary to achieve successful application of the new gas storage theory.

First, the cap rock that will serve as a "lid" to the container must be a dense material—such as compressed shale or other impermeable material—that will not allow passage of a fluid (a gas or a liquid).

Beneath the cap rock there must be a sandstone of sufficient porosity to serve as storage space.

Also important are permeability of the sandstone and depth of the formation, which determines to some extent the static pressure in the storage area.

Formation Requirements

The best type of sandstone for a "bubble storage" project is one that has a preference for water—rather than a preference for oil. This is called a "preferentially water wet" formation and is a characteristic of sandstones that are deposited in a marine environment. Even if the formation contains no "connate water" (water that originally filled the pore spaces in the sand and which may have migrated elsewhere) the sandstone has a higher attraction for water.

With a sandstone such as this beneath the cap rock, it is necessary to inject only enough water to saturate the zones surrounding the wells (located on the perimeter of the proposed storage area) so that these zones will connect and form the circular-shaped barrier.

At the site selected by Northern Illinois, the St. Peter sandstone used as

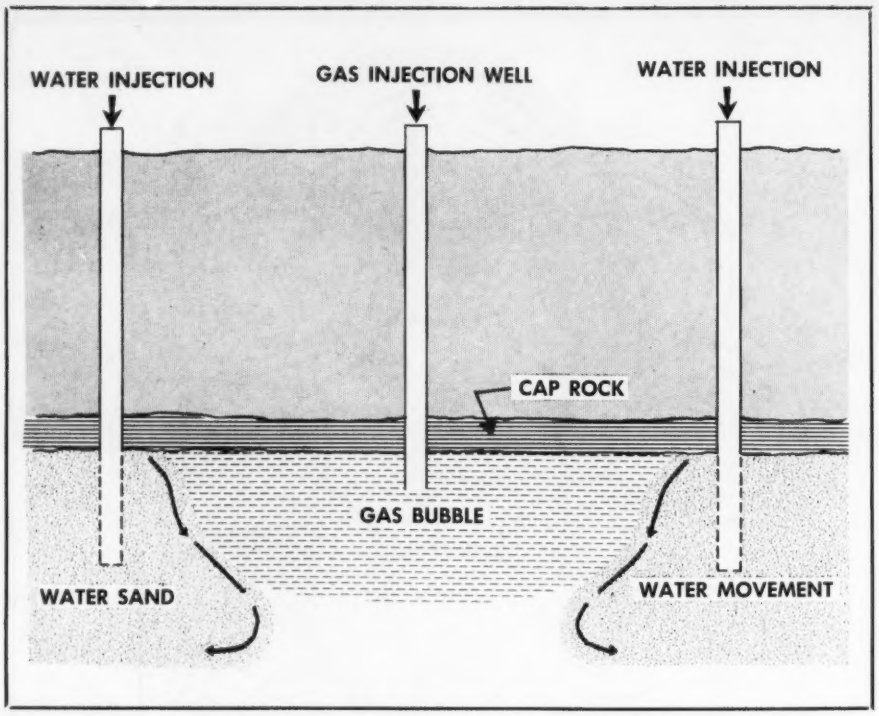


FIG. 2. Bubble storage under a horizontal cap rock. Cross sectional view illustrates how "wall of water" would confine gas inside the "container." Capillary pressure of water in sand pores would prevent gas movement.

the storage formation is filled with water, and is approximately 150 ft thick.

Overlying this sandstone is a dense limestone — part of the Trenton structure — which serves as the "cap rock."

The water injection wells are drilled to approximately 1000 ft below the surface. Into these wells, sufficient water is injected to increase the hydrostatic pressure from 50 to 100 psi above the normal static pressure of the formation — which is approximately 450 psi.

Beneath the sandstone formation is another thick rock layer, composed of limestone and shale.

The water injected into the 8 wells around the circle is expected to form a series of connecting zones and seal off the inner chamber.

Gas injected in the center is expected to spread downward and outward, forming a mushroom-shaped bubble, similar to that shown in Fig. 2.

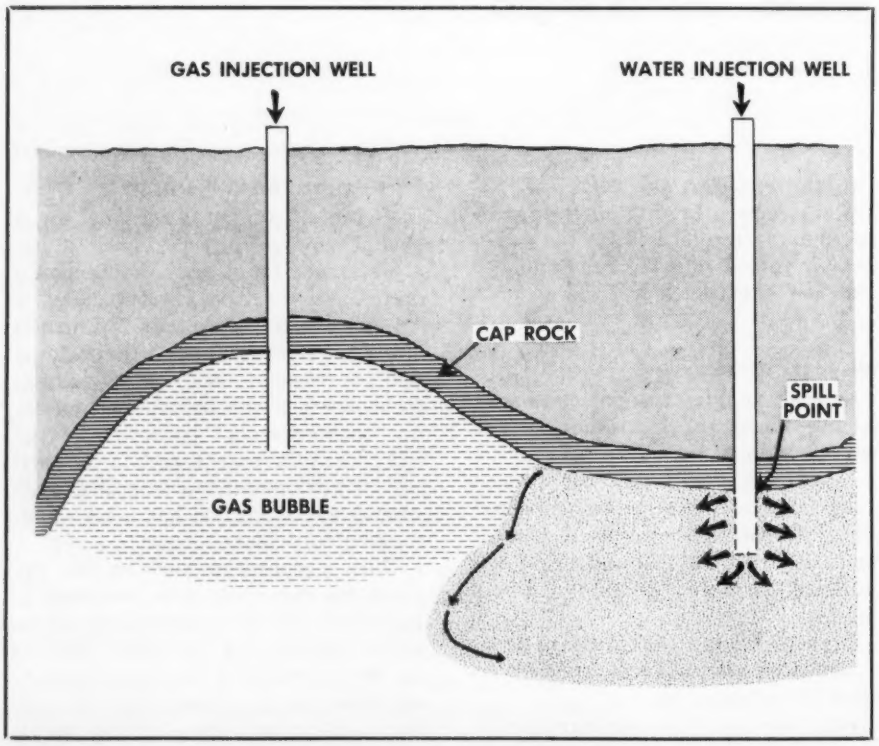


FIG. 3. Wall of water on horizontal side of a cap rock structure with three downward-sloping sides would make useful storage container out of a dome that would otherwise be abandoned. Many such structures have been found.

Where It Can Be Used

Northern Illinois, looking ahead to future gas demands on its system, is seeking more underground storage reservoirs. There is a shortage of "ideal" storage areas, consisting of a dome-shaped cap rock (similar to an inverted saucer) over a sandstone formation into which gas can be forced and held under pressure.

Quite often, in their search for such formation, NI-Gas engineers have found a cap rock with three downward-tilting sides and one that is horizontal. Gas forced into such a structure would escape from the horizontal side.

If this horizontal side could be sealed-off with a "wall of water," then the resulting reservoir would hold gas as well as any natural dome.

Similarly, a tight cap rock that is completely horizontal could also be used if a circular wall of water could be put under the cap rock "lid."

The tests now underway at NI-Gas' Station 147 at Matteson, east of Joliet, will also provide answers to such questions as relative costs of the new method, volumes of water required, and methods and rates of injecting water.

If successful, the experiment will make possible the use of flat storage reservoirs for underground storage of natural gas . . . and is expected to be of interest to many utilities located in areas where natural storage formations just aren't available.

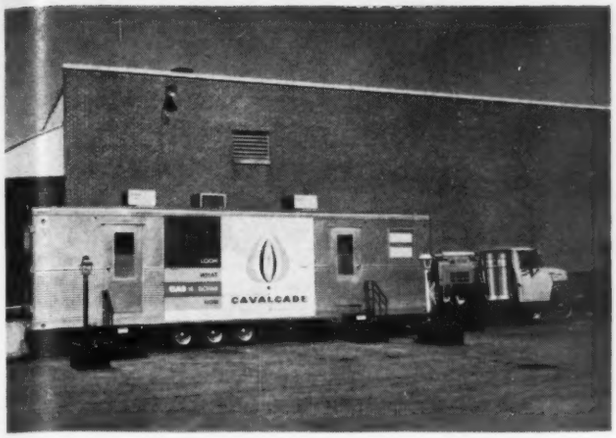
Ends Justify Means

Like most gas distribution companies, Northern Illinois Gas is faced with growing demands on its system. On cold winter days, customer demands greatly exceed available supplies. In the summer, supplies greatly exceed demands.

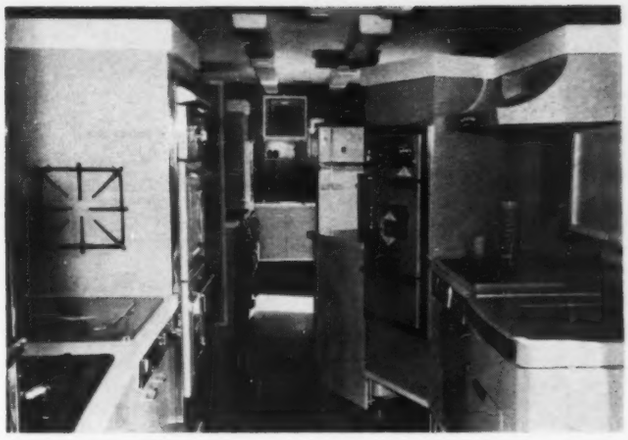
Ideally, the company can store gas in the summer and make it available in the winter for "peak shaving" purposes. Underground storage is the best method for accomplishing this.

NI-Gas anticipates that it will need several new storage reservoirs in the next five years in close approximation to its northern Illinois service area.

If the present experiment is successful, these will be easy to find. ★ ★ ★



ONG's Blue Flame Cavalcade Trailer will travel 3000 miles in the first six months this year, offering Oklahomans a look at the latest in gas appliances.



Although many appliances are shown, every effort was made to keep the display from being too crowded.

The Store That Goes To The Customer

Mobile gas appliance display — "Blue Flame Cavalcade" — is being shown by Oklahoma Natural Gas in approximately 70 cities and towns in its service area . . . as well as home shows, shopping centers, fairs, exhibits, etc. . . . wherever potential customers might be found.

Lester L. Wildman, *Sales Promotion Department*
Oklahoma Natural Gas Company, Tulsa, Oklahoma

TELLING THE PUBLIC about new and different gas appliances and their uses is a never ending task. It is a job that is much too important to leave to chance. Many customers keep informed by visiting appliance stores.

For those who don't, Oklahoma Natural Gas virtually takes the "store" to them . . . via its *Blue Flame Cavalcade*. Through the medium of its Cavalcade trailer, ONG has shown "what gas is doing" to over 20,000 people in slightly over two months.

Incorporated into the 36-ft aluminum trailer display unit is everything from a gas light to a 15-kw gas-engine-driven generator.

Each day the Cavalcade "plays" to an audience of from 50 to 450 people. "On stage" to explain details of new innovations in gas appliances are a home service director and a sales representative. They not only explain and provide literature on the appliances shown, but also take names of prospects for local dealers.

Daily records are kept by the driver-manager of the Cavalcade, and a tight schedule of "showings" is maintained despite rain, snow, and ice.

Demonstrations of a vertical broiler range installed in the trailer are made for home economics classes from local high schools that visit the display. The range — and a "no-vent" heater — are both connected to gas supplied from two 30-gal LPG tanks mounted on the front of the trailer. The heater is also used for comfort of visitors and workers in cold weather.

Outside the trailer are two portable gas lights (operated from small, concealed butane bottles), with each light in its own simulated brick planter. The lights can be strategically placed to attract visitors to the Cavalcade trailer display. (The lights also rate high among appliances desired for immediate purchase by visitors.)

Inside the trailer is featured a "dream" kitchen that includes:

. . . a display panel illustrating how gas air conditioning can fit into any home. Flashing red lights show the path of air for heating while flashing green lights indicate changes in the system for cooling.

. . . a new gas refrigerator, which makes "magic ice circles" for visitors.

. . . a range-top rotisserie-grill.

. . . a 1960 model built-in range, complete with a "burner with a brain."

. . . a matching built-in oven featuring automatic roast control, clock controlled oven, and smokeless broiling.

. . . a 1960 free-standing range with charcoal black porcelain and chrome top.

. . . a modern home laundry unit that includes an inconspicuous under-counter gas water heater and a washer-dryer combination.

. . . "fold-away" counter-top cooking units; a built-in griddle that is thermostatically controlled; a gas clothes dryer with disposable lint filter; and matching "color co-ordinated" hoods for cooking units. ★ ★ ★

Appropriate utensils and accessories are unpacked at each stop to display appliances in a most favorable atmosphere.

Compact Cars: Status Report

Dean Hale, *Editor*

COMPACT CARS haven't become a dominant force in the automobile fleet operations of gas distribution companies, but certainly no one is overlooking them. Most companies, in fact, are either buying compact cars or have them "on test." Some are enthusiastic over the smaller vehicles, while others have reservations about their utilization.

Performance of compact cars in relation to standard models was reported during a panel session sponsored by the automotive and mobile equipment committee of the A.G.A. Operating Section during the latter group's annual convention in New Orleans recently.

Panel members represented five major gas utilities serving major population areas in the northern, eastern, and north central regions of the U. S. In each case, the utilities have experimented with compact cars and kept close records of costs of operation, gasoline mileage, and maintenance and repairs.

Mileage experience of the five companies varied widely. One company reported up to 18 miles per gallon . . . another's figures ranged down to a low 10.8 m.p.g. Some of the difference in mileage, the companies agree, can be attributed to difference in ability of drivers to properly operate the smaller vehicles.

. . . But a company shouldn't decide to buy or not buy compacts based on driving experience with just one compact car—the mileage difference alone can be attributed to driver habits.

. . . Compacts, notes one company, generally give 3 to 4 m.p.g. more than standard models.

Automatic transmissions are becoming popular on fleet vehicles. One company, which is buying a lot of compact cars, says that its experience in maintenance costs has proved that automatic transmissions "belong on fleet vehicles." Another company notes that automatic transmissions will reduce gasoline mileage from 2 to 4 m.p.g., compared to standard shift vehicles. One company even reported that it had converted "stick shift" models to automatic transmissions.

Operating costs (gasoline, maintenance, repairs) for compact cars range anywhere from "much lower" to "about the same" as those for standard models.

Foreign-made small cars aren't very popular with fleet operators. Only one company reported owning any of the small vehicles and it plans to replace them with domestic-made compact cars. Similarly, a "show of hands" poll taken of the panel and its audience revealed that none of the fleet operators are buying or plan to buy foreign-made small cars. Reasons include lack of parts, lack of service facilities, and pressure to "buy American-made products."

Initial costs for compact cars range

U.S.-BUILT SMALL CAR COMPARISON CHART*

Make	Overall Length	Wheel Base	Over-All Width	Engine Horse-Power	Displ-acement (Cu. In.)	Auto. Trans. No. of Speeds	Over-drive?	Power Steering	Power Brakes	Luggage Compartment Capacity (cu. ft.)
Corvair	180	108	66.9	80	140	Yes-2	No	No	No	11.3
Falcon	181.2	109.5	70.0	90	144.3	Yes-2	No	No	No	23.7
Lark	175	108.5	71.3	90	169.6	Yes-3	Yes	Yes	Yes	16.5
Rambler	178.3	100	73.0	90	195.6	Yes-3	Yes	Yes	No	17.7
Valiant	184	106.5	70.4	101	170	Yes-3	No	Yes	Yes	24.9

*Based on information available from manufacturers' literature and other published reports.

Domestic-made small cars are making inroads in big utility fleet operations but not everyone is convinced that they'll be big money savers

from $100 to $300 less than prices for basic models of the "big three" automobiles. But, as one panel member pointed out, part of the difference is due to optional equipment available on large cars that you can't get on the compacts.

"Trade-in" or resale values of compacts will undoubtedly be lower than for standard models, but the price differential won't be as great as the initial cost differential. And, if compacts retain the public favor, they might even have higher resale values than standard models — at least with regard to amount of initial cost that is recoverable.

Company No. 1 . . . a large eastern combination gas and electric utility, is not overly impressed with compact cars. It feels that a small increase in the cost of maintenance and repairs (compared to standard cars) would wipe out any advantage in the savings in operating costs that might be gained with the smaller automobiles.

The company, which owns several compacts, found that the best of the small cars produced 17.8 m.p.g., while the poorest performance was 13.83 m.p.g. for a group of compacts assigned to "work service." Standard vehicles, by contrast, averaged 13.78 m.p.g. The standard vehicles are "stripped" models, with 95 percent of them two-door models.

Annual operating savings of about 4.5 percent are possible with the compacts, the company believes, amounting to about $57 per year per vehicle. Fuel savings alone account for $32 of this amount. To obtain such fuel and operating savings, the company feels that drivers must be properly trained in operation of the smaller cars.

While other savings are possible, chiefly a reduction of $200 to $250 in initial price compared to standard autos, the company feels this much or more might be lost in resale, especially if the compacts lose their public acceptance.

Company No. 2 . . . reports it is getting about the same mileage from compacts that it gets from its standard automobiles.

Average vehicle operated by this company — a large midwest gas utility — is a Ford or Chevrolet 6-cylinder, usually equipped with automatic transmission, and is "fully rigged" complete with two-way radio equipment. These standard vehicles average about 11 m.p.g. while doing 8700 miles annually.

For comparison, a Studebaker Lark "on test" averaged 10.8 m.p.g. while doing 6200 miles per year and a Rambler "on test" averaged 12.8 m.p.g. while travelling 7200 miles per year.

Cost of operation, the company reports, is about the same for both compacts and standard cars. Biggest difference is in initial cost — the company notes that the Lark and Rambler can be bought for about $300 less than standard Fords and Chevrolets. Part of the difference is due to optional equipment available on the larger cars that isn't available on the compacts. Overall savings appear to be about 13 percent with the smaller cars. Company presently has a dozen Larks and a dozen Falcons and is giving them further tests.

Company No. 3 . . . a large eastern combination gas and electric utility, began its venture into the small car field with a foreign model — the Anglia — and frankly admits that the results weren't completely satisfactory. It purchased 18 of the Anglias in 1958 and assigned 6 each to its commercial department (meter reading, etc.), customer service work, and electrical distribution department.

Troubles with the foreign models included oil leaks due to oil seal failures, brake line leaks, and transmission failures. Spare parts were difficult to obtain. All of the Anglias are to be replaced — and 12 of them have already been replaced.

During 1959, the company purchased 54 U. S.-made compacts, including Larks, Rambler Americans, and Ramblers. These vehicles have proven satisfactory. The company notes that they are "comfortable for the driver" and cites the advantage of "ease of parking" among reasons for liking the domestic compacts. Parking ease, espe-

cially, is a vital factor in selection. While the U. S.-made compacts have been owned less than a year, their operating experience has been good. Only a few minor repairs have been required.

During the first quarter of 1960, a comparison of the cost of gasoline and repairs looked like this:

Anglias	$0.0048 per mile
Lark	0.0038 per mile
Rambler	0.0042 per mile
Rambler American	0.0032 per mile
Ford (Standard)	0.0059 per mile
Plymouth (Standard)	0.0063 per mile

While the comparison favors the compacts, the company noted that the smaller cars had been in service less than a year, while the 467 Fords had an average of 47 months of service and the 734 Plymouths had an average of 41 months of service.

Use of compacts, the company estimates, could mean annual savings of $54,000 in gasoline and repairs.

Encouraged by the results of its compact car experience, the company plans to buy an additional 218 compacts in 1960 — Falcons, Larks, Ramblers, and Valiants — and by 1961 plans to fill 95 percent of its passenger car fleet requirements with the small cars.

Company No. 4 . . . a large midwest gas distribution utility, is buying the smaller Falcons in place of standard Fords "almost without exception." It also is buying Valiants, but has not had sufficient operating experience with them for precise evaluations. No foreign cars have been purchased.

Nearly half of the company's passenger car fleet is used on route (customer service) work . . . with passenger cars preferred over light trucks for this type operation. New cars, as purchased, are assigned to supervisory personnel and the vehicles they replace are transferred to route service. Company's replacement policy is generally based on six years' service or 75,000 miles.

Savings with compacts to date have averaged about $120 annually. Company noted that it didn't get a big discount when purchasing its compacts because of a "seller's market" . . . the "big three" had more buyers for its small cars than it had cars to sell.

Better gasoline mileage — up to 40 percent more — was reported for the compacts. The small cars averaged 16.8 m.p.g., compared to 12.0 m.p.g. for standard cars . . . the figures for both types include use in customer service work, as passenger cars, etc.

Other savings are minor, with up to 10 percent saving reported on liability insurance and some (but not much) saving on personal property taxes.

Suitability of purpose for the compacts varies, the company noted. The Falcon is able to handle the company's vehicle requirements in all cases, and is now being bought and used in place of standard Fords.

The Corvair didn't do as well — design of its interior and trunk space makes it difficult to adopt to customer service work. Valiants are being tested and seem equally adaptable to all vehicle requirements.

Company estimates it can save $450 per vehicle in six years (its average vehicle life) by using compact cars. It sees no extra cost in repairs for the small cars compared to standard models, and finds them just as reliable as a "full-size" vehicle.

Admittedly, says the company, the compacts may prove to have a shorter economical life and a lower "trade-in" value, but it notes that the small cars cost less initially . . . and it believes they will last as long as any "standard" model.

Company No. 5 . . . which operates gas properties in a number of eastern and north central states, likes compact cars. It plans to add some 800 of them to its fleets as replacements for existing standard vehicles.

Currently, the company has 53 compacts in service and 38 on order. The initial units have travelled some 8000 miles each and are averaging 18 m.p.g. This is roughly 5 m.p.g. more than it gets from its standard models.

Economy of operation is important to the company, which operates some 3600 vehicles, including some 1200 passenger vehicles. The company has four classes of passenger cars: Class I, about 1000 vehicles, includes basic models of Ford, Plymouth, and Chevrolet; Class II includes larger models of the Ford (Fairlane 500), Plymouth (Belvedere), and Chevrolet (Bel Air) plus basic models of Dodge, Mercury, and Pontiac; Class III and IV include the larger models of Dodge, Mercury, and Pontiac plus some Oldsmobiles and Chryslers.

Classifications are based on job requirements for the vehicles (for classes I and II) and on personnel assignments for new class III and IV vehicles.

A new replacement policy, designed to give more economical fleet operation, was partly responsible for considering selection of compact cars in place of standard cars. Present replacement policy is based on 45,000 miles usage or 3 to 4 years' service.

The company tested extensively various models of the U. S.-made compacts before deciding to go the small car route. Models of the Lark, Rambler American, Falcon, Corvair, and Valiant were tested under actual working conditions and driven by many different drivers. Records were kept of vehicle operation cost and no service or repairs were made in company garages — so that an accurate cost analysis could be made.

Four controlling factors justifying use of compacts, the company feels are:

1. Safety
2. Maintenance
3. Driver comfort
4. Recovery cost on resale

The company believes that automatic transmissions belong on fleet automobiles and notes that its studies have proved this by maintenance experience (or, better, lack of maintenance required) on vehicles so equipped.

Studies of the compact cars, reported the company, show that the compact cars have sufficient power to meet job requirements, have adequate tool space, adequate seating space, sufficient ground clearance for operation in rural areas, and that the shorter wheelbase is helpful in today's driving and parking.

Compact cars also cost about $200 less initially than the basic Ford-Plymouth-Chevrolet models, the company found.

Evidencing its belief in the compact car, the company plans to buy 200 each years for four years, beginning this year. At this rate, the company will save $40,000 in 1960 on initial costs alone, and expects to save another $18,000 in fuel costs if the compacts produce the extra 5 m.p.g. anticipated. In a four-year period, savings accrued in initial costs and operations for the 800 cars (at 200 added per year) will be approximately $300,000.

A major west coast combination utility, reporting from the floor during the discussion period after the panel presentation, noted that it was getting 20 percent better mileage with compact cars.

This company operates 2000 passenger cars in its vehicle fleet . . . and presently has 200 compact cars. By the end of 1962 it plans to have some 1200 compacts in its fleet. Compact cars will replace light pickup trucks now being used by meter readers. Company also reported that four of its compact cars with automatic transmissions had already traveled 40,000 to 50,000 miles without any problems . . . which it considered "very good."

A medium-size eastern combination utility, which operates 150 passenger cars in its vehicle fleet, reported from the floor that it plans to put 18 Valiants into service this year. It plans to use them in suburban areas, where vehicles can run up considerable mileage in making service calls because customer density is far less. * * *

Many potential industrial applications exist for gas-fired high-temperature radiant sources and surface combustion processes; greater interest and utilization — and benefits to the gas industry — expected to result from . . .

New Studies of Porous Medium Burners

W. R. Staats, E. A. Roth, *and* **R. T. Ellington**
Institute of Gas Technology, Chicago, Illinois

MODERN HEAT PROCESSING DEVELOPMENTS continue to demand increases in heating rates and precision of application. Efforts to meet these needs include designs to increase convective transfer coefficients, and to capitalize on the high fluxes obtainable from high-temperature radiant sources. The interest in radiant sources has led to a significant revival of interest in the porous-diaphragm, or porous-matrix, burner, and the surface combustion process.

Interest in surface combustion has periodically surged and waned since the earliest known description in 1817. First applications of surface combustion in porous matrix burners date from the development of the Welsbach mantle in 1885, and Bone's work on porous diaphragms around 1910. A flurry of activity took place immediately after World War I, and then interest apparently died again for a lengthy period.

In the last decade considerable work on the basic process of surface combustion has appeared in Russian literature. More recently some U. S. furnace manufacturers have been advertising embodiments of porous-matrix burners, such as porous-wall firing. Recently described applications requiring precision in control are the furnace brazing of stainless steel honeycomb sandwiches for advanced aircraft structures, and as a confined source for investigations of direct conversion of heat to electricity.

The porous-diaphragm burner consists of a porous matrix, usually of refractory material, fed with a near-stoichiometric gas-oxidant mixture. In proper operation, the combustion wave is stabilized on the downstream face of the matrix. Under certain conditions, however, the combustion wave may retreat from the surface, and if it passes through the matrix, cause a dangerous flashback in the mixture line. This situation is obviously undesirable, and there is little published information that would be of help in the design of these burners for proper operation. Accordingly, the Institute of Gas Technology initiated study of the "retreat" phenomenon to help the gas industry use this type of burner effectively.

Basic Processes Involved

In analysis of the basic processes involved, it is necessary to consider such factors as:

Rate of flow of the combustible mixture through the porous medium,

Burning velocity of the flame,

Heat conduction from the face of the burner back through the porous medium and into the gas stream, and

Rate of heat loss from the burner face by radiation and as sensible heat of the combustion products.

The physical properties of the material of which the porous matrix is made, and the manner in which the porous structure is formed, affect its overall behavior.

The physical properties of the mixture fed to the burner, and the combustion phenomenon itself, also affect the behavior.

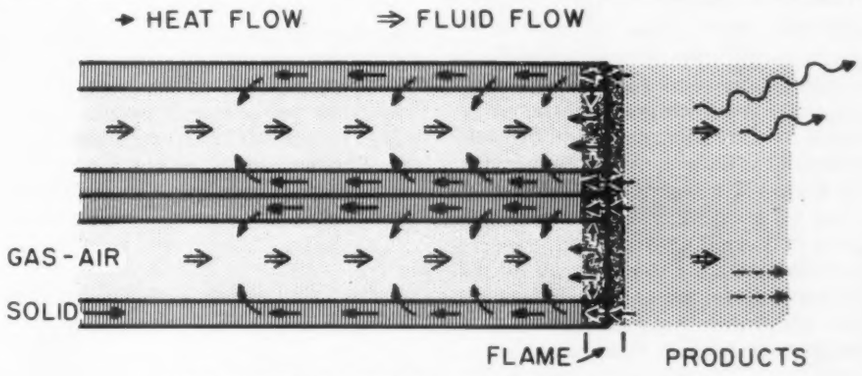


FIG. 1. **Simplified model of combustion** in a porous matrix.

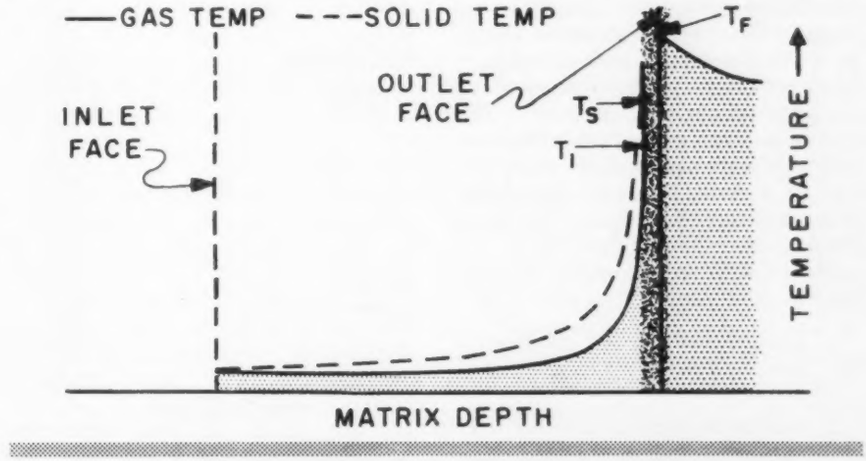


FIG. 2. **Representative temperature profiles** in porous matrix burner.

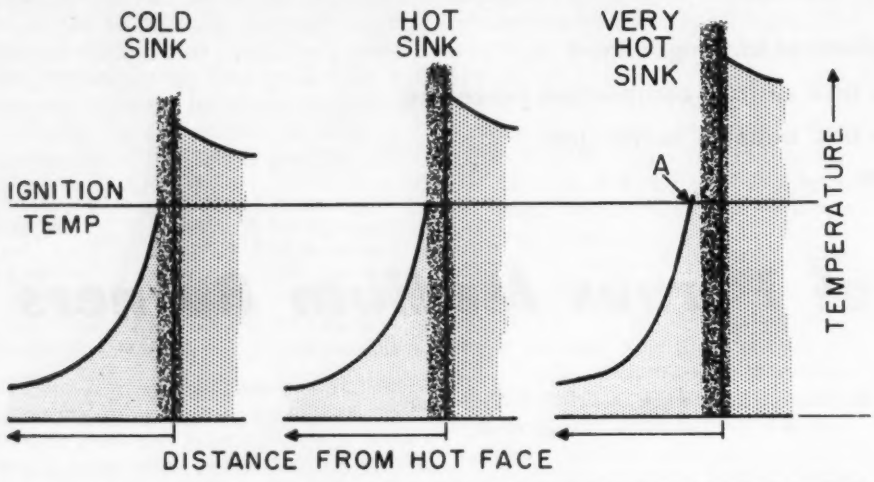


FIG. 3. **Change in feed gas temperature profile** with change in surface temperature.

The combustion phenomenon has two phases:

1. In ignition of a porous medium burner from a cold start, the gaseous mixture burns above the surface, as on a multiport burner, with coalesced flames. Heat is transferred from the flame to the surface of the porous medium.

2. The surface reaches a temperature at which it becomes active in promoting the combustion. The flame front then pulls down to the surface, which becomes incandescent.

It is difficult to say whether, in Phase 2, the reaction occurs at the exit of the pores, with heat transfer to the solid to make it incandescent, or at the gas-solid interface, with heat transfer to the gas to bring the products to their final temperature. There is little difference between the two as far as the present discussion is concerned, but the difference is great for mathematical analysis, and this is one facet of the study underway at IGT.

Idealized Model

When the reaction has started at the face of the burner, the basic heat and material flows are as shown in Fig. 1, in which the matrix is idealized as a bundle of capillary tubes through which the combustible mixture passes. The heat of reaction of the fuel is liberated within the very narrow flame zone, and we will assume that the combustion products leave this zone at the same temperature as that of the solid.

Heat will be lost from the reaction zone by four paths:

a. *Sensible heat in the combustion products,* as shown by the dotted arrow,

b. *Radiation from the gas and solid surface,* as indicated by the wavy arrow,

c. *Conduction through the solid body of the matrix toward the interior of the porous medium,* as shown by the arrows in the solid body, and

d. *Conduction into the reactant stream,* as shown by the single arrows, *against the direction of flow,* which is shown by the double arrows.

When steady state has been reached, none of these flows varies with time, and the temperature at any point in the gas or solid phase remains constant. It should be noted that the heat conducted back into the solid matrix will be picked up from the pore wall by the flowing reactant stream, and two temperature profiles will be set up in the burner, one for the solid phase and one for the flowing reactant stream.

Temperature Profiles

Temperature profiles such as might be set up during steady state operation are shown in Fig. 2. It should be noted that with a very thick medium, the temperature of the entering reactants and the inlet face of the solid should be nearly the same. At every other point within the burner, the solid will be at a higher temperature than the reactant stream in the pore space. The rate at which heat is transferred to the gas will depend on the local film coefficient, and temperature difference.

It is important to note that as the reactant stream is heated toward the final temperature of the downstream surface of the medium, it will finally reach its ignition temperature, T_i, or the solid will reach the temperature at which it becomes active in promoting the combustion reaction, T_s.

For simplicity in completing the discussion of the stability situation, it is worthwhile to select one of the reaction schemes that might occur:

1. Burning in the gas phase with heat transfer to the solid, or

2. Burning on the surface of the solid.

In this case the discussion will be based on combustion occurring in the gas phase, and initiated at the ignition temperature of the reactant. When the ignition temperature of the mixture is reached, reaction will occur very rapidly, and the reaction products and surface will almost instantly be brought to the final temperature, T_f. The stability of the reaction zone can be described in terms of the temperature profile in the feed gas.

Fig. 3 represents the temperature

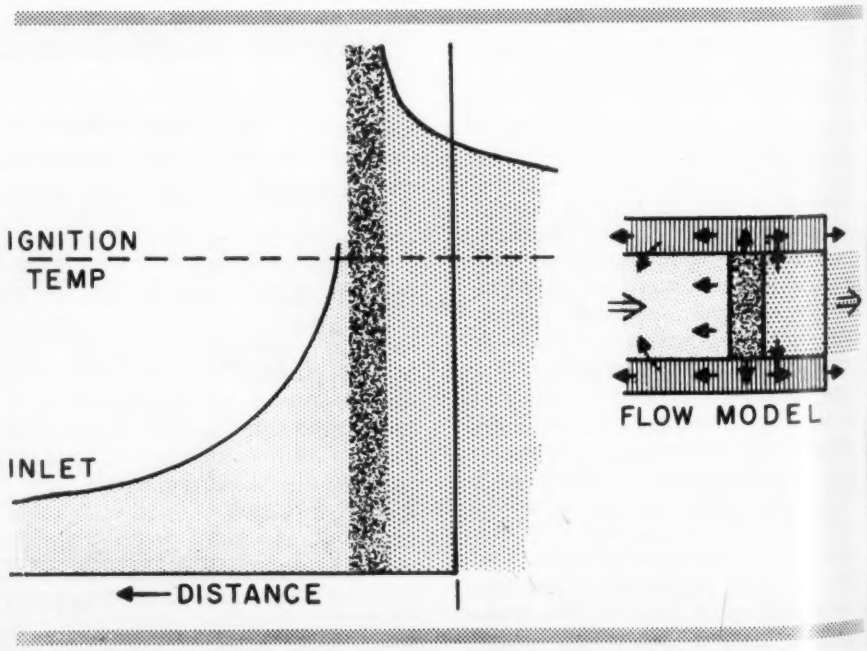


FIG. 4. **Temperature profile and flame position** with flame retreat.

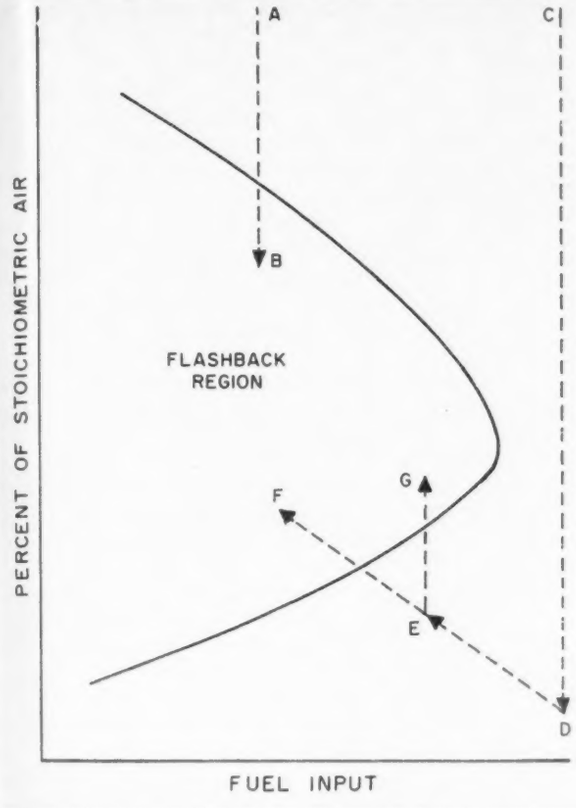


FIG. 5. **Diagram of the operating condition paths** followed to reach the flashback point.

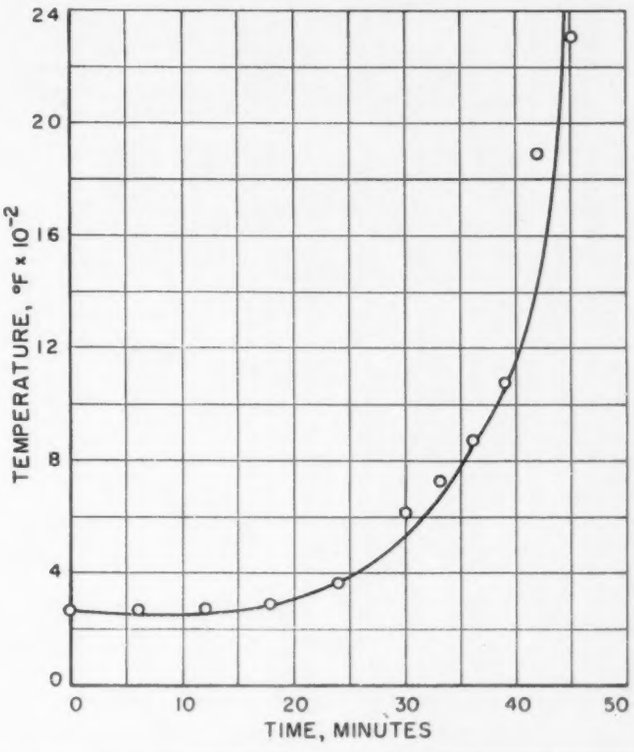


FIG. 6. **Temperature history** of flashback.

profile of the gas for three different burner environments. In the first case, the burner surface is radiating to cold surroundings, and the burner surface temperature will be relatively low because of the high rate of heat loss. A relatively small amount of heat will be conducted back into the matrix, and the temperature profile of the reacting gases will rise very rapidly as the reaction zone is approached. In this case the reactants will reach the ignition temperature practically at the surface, and there will be no tendency for the combustion zone to retreat into the matrix.

The center section of Fig. 3 shows the temperature profile for the same burner matrix and feed rate. The burner now radiates to surroundings at several hundred degrees, with the result that the burner surface temperature is increased due to the heat radiated back to it. The reactants now reach ignition temperature slightly deeper within the matrix. This point is not sufficiently far from the surface, however, to give any tendency for the combustion zone to retreat into the matrix.

The right-hand section of Fig. 3 shows the gas temperature profile for the same matrix and feed rate, but with high-temperature surroundings. The burner surface temperature is further raised by the increased radiation incident upon it. There is more heat conduction back through the solid material, with the result that the profile is less steep as it nears the surface. The important thing to note is that the reactants are heated to their ignition temperature at point A, before they reach what is presently considered the reaction zone. The result will start at point A, and will proceed rapidly, and the combustion zone will increase in depth.

Combustion Zone Retreat

The combustion zone retreat situation is shown by the temperature profile in Fig. 4. As soon as the combustion zone has deepened significantly, as a result of the profile shown in Fig. 3, the downstream face of the burner will be heated only by product gases leaving the combustion zone, and wall-conduction from the combustion zone. The combustion zone will not lose heat by radiation as rapidly as it did previously. The result is that the temperature of the combustion zone increases markedly, and may approach the theoretical flame temperature of the mixture, while the temperature of the external face of the matrix may drop somewhat. Then, the conduction into the cold portion of the matrix will be further increased, and the temperature profile further flattened, so the mixture will tend to continue to reach its ignition temperature before arriving at what was previously the combustion zone. Thus, the combustion zone will continue to retreat into the matrix in a manner similar to flashback in the ordinary burner.

It is now possible to interpret the retreat phenomena in terms of the makeup of the burner, and operating variables. If the flow rate of the feed is increased, each unit of the feed will be preheated less, and the temperature profile will be steepened. There will be less tendency for a combustion zone retreat if none of the other properties of the system is changed. As the combustion of the mixture fed to the burner is varied from the stoichiometric point, less heat will be released per unit of feed, and the combustion zone temperature will decrease. This will result in less tendency to flashback.

The less the thermal conductivity of the material of which the matrix is composed, the less the heat conducted into the interior of the burner for a given surface temperature, and the less the tendency to flashback. If the temperature of the face of the burner is increased by immersion in a high-temperature furnace so the net heat loss is reduced, the tendency for flashback increases.

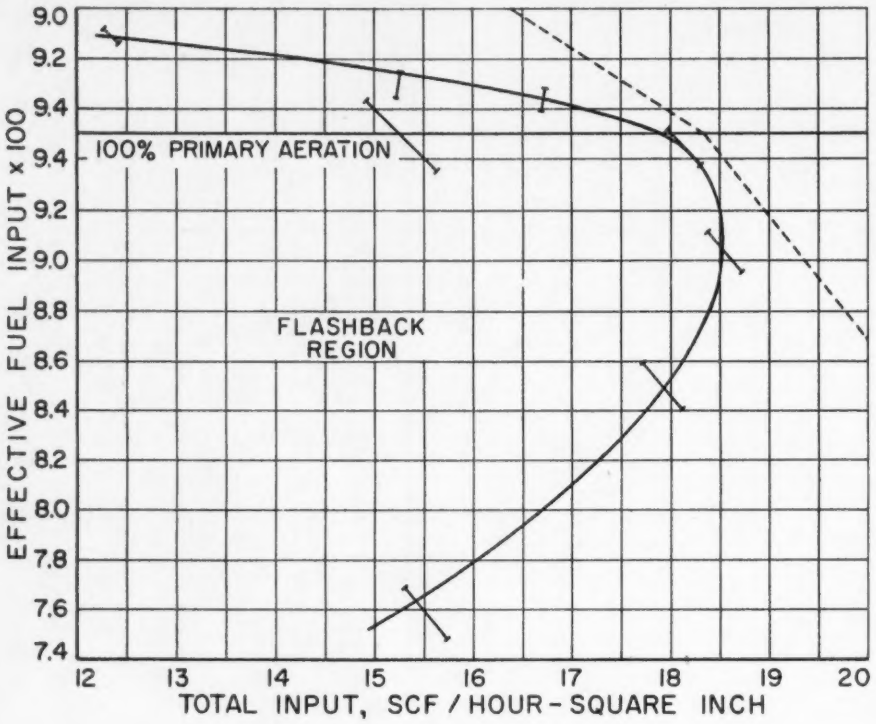


FIG. 7. **Flashback limits** for one furnace temperature.

Experimental Equipment and Procedures

The experimental setup being employed to investigate the effect of these variables consists of a simple cubical box furnace designed to act as a constant-temperature enclosure for the test burner. Wall burners in the furnace permit variation of enclosure temperature, independent of the setting of the test burner in the furnace hearth. The gas-air mixture fed to the test burner is independently variable, and is accurately metered. The surface temperature of the test burner is monitored by use of a radiation pyrometer, and thermocouples are imbedded in the matrix at various depths.

The boundaries of the unstable region were approached along several paths, as shown in Fig. 5. At a given fuel input, the burner air was gradually reduced, while the furnace temperature was held constant, i.e., path A-B. Flame front retreat was detected by the thermocouples in the matrix. A second approach was to increase the fuel input to such a value that retreat could not occur, and the air was reduced along path C-D. Then the fuel input was decreased, giving path D-E-F, or reduced a minor amount to give path D-E, and the air was subsequently increased to give path E-G. At the present time the feed conditions are fixed, and the surface temperature is increased until retreat occurs.

The observed history of a combustion zone retreat is shown in Fig. 6. This gives a rough idea of the rate at which the combustion zone proceeds through the matrix. The rate of travel is obviously not great at these particular conditions. The peak temperature of the wave is so high that the monitor thermocouple was always destroyed unless the retreat was stopped when the rapid temperature rise started.

Stability Limits

It is fairly apparent that the stability limits of a porous-diaphragm burner are going to be affected by a number of factors. Among these are properties of the matrix, such as its porosity and thermal conductivity. The most important operating conditions are the gas-air ratio of the feed, the input rate in Btu per hour per square inch of matrix surface, and the operating surface temperature.

The stability limits for one matrix, at a temperature on the order of 2300 F, are shown in Fig. 7. From it a number of interpretations can be made. The effective fuel input is the heat liberated per cubic foot of mixture, divided by the heat liberated per cubic foot of stoichiometric mixture; this is plotted versus total gaseous flow, i.e., gas plus air. Starting in the fuel-rich region below the curve, and increasing the air input, would increase the amount of heat liberated and favor flashback. Starting above the curve and decreasing the air input also increases the heat input per unit mass of flow. Thus the curve would be expected to have two branches. The dotted line represents an input of 1740 Btu per hr per sq in., along which no flashback occurred with this matrix. The boundary curves for lower surface temperatures would lie inside the curve shown, and vice versa.

Near-stoichiometric mixtures were fed at rates up to about 2500 Btu per hr per sq in. of matrix. This is substantially more than was recently reported for a cylindrical porous burner, and by no means represents a limit on heat input. These fluxes represent one of the major reasons for recurrence of interest in these burners.

The logic of some of the control methods used for porous wall furnaces is quite apparent when the stability limits are examined. In one method, the air continues to flow, and the fuel is cycled on and off by the controller. This means that even though high furnace temperatures and flow rates that would represent points inside the stability curve are used, combustion zone retreat is periodically quenched by air flow.

The operating limit of a given burner may well be determined by the composition of the matrix. The surface temperature must be kept beneath the temperature at which the matrix softens to the point that its pores tend to close. As our work continues, we hope to investigate the behavior of higher-temperature materials and preheated feeds. One point on which we will have to gain more experience is the apparent fluxing of the matrix by contaminants picked up in burner preparation. On occasions, the melting has been quite severe. Cavities have also formed in the matrix during combustion zone retreat, apparently from fusing of the matrix at the peak temperatures reached.

At this point in the investigation we are enthusiastic regarding the potential of these burners. They certainly have not been exploited fully, and we hope that the information we are gathering on their behavior will help the gas industry exploit them to the utmost.

Acknowledgment

This study was initiated under the Institute of Gas Techonology's Basic Research Program, supported by IGT's Members and Contributors. It has been furthered by grants-in-aid from the Whirlpool Corporation and the PAR Plan of the American Gas Association. Suggestions by Dr. Henry Robinson and others at Whirlpool have been most helpful. This article is an adaptation of a presentation made to the 1960 A.G.A. Industrial and Commercial Gas Sales Conference, Houston, Texas.

* * *

Control of Construction by Contractors

Adequate and clearly worded contracts and specifications plus conscientious and effective effort to maintain good cooperation between contractor and company can be advantageous to both parties

B. Frank Harris, Jr., *Assistant Superintendent, Gas Distribution, Baltimore Gas & Electric Company, Baltimore, Maryland*

GAS DISTRIBUTION COMPANIES in the past few years, have shown increasing interest in levelling their gas main and service line construction work load by using contractors to do "peak shaving." The "peak shaving" of construction work load by using contractors reduces the magnitude of the work load variation of a utility's own forces.

Why use contractors for construction of gas distribution facilities?

Answers to this question and other observations made here are not to be confined to the activities of contractors doing work for the Baltimore Gas and Electric Company, but include those employed by other gas distribution companies as well.

Some companies that have peak demands for construction labor during the summer months have found it profitable to use contractors during these months rather than hire seasonal labor. Temporary labor is generally less productive and presents other problems which do not generally exist with permanent personnel. Additionally, the use of contractors makes it possible to keep overtime work at a minimum. Of course, a *special* job requiring specialized equipment, or engineering "know how" may make it necessary to use contractors at any time, since it is usually not economical to maintain special equipment and personnel for such projects.

The number of contractors' forces used range from a maximum during the heavy construction months to a minimum during the light construction period. The wide fluctuations in volume of work contracted does not seem to make the work too unattractive to the contracting companies. Of course, the contractor has some of the same problems facing him that face the utility, that is, he must find other work for those forces released by the utility during the off-peak season.

The control of contractors' activities begins in the office with the engineering, legal, and insurance groups preparing contracts and specifications that will be guide lines for the contractor and for company personnel responsible for his performance.

Contracts and specifications should be clear and concise, leaving no doubt as to intent. Simplicity can be obtained by using local contractors who have acquired local experience and developed a system of team work with the utility company.

Specifications for an "outside" contractor, especially on a complex project, must be more specific to avoid being charged for "extras" to compensate a contractor for intentional low lump sum bidding.

A second phase in controlling a contractor is in the method of bidding. Here are four of the more popular methods.

1. Blanket or Unit Bidding. This type is effectively used for work to be done in new housing developments or where unforeseen difficulties can be expected to be at a minimum. Competition is based on the per foot cost of pipe installed, with payment for accessory items being the same for all contractors. *The* per foot cost *includes excavation, welding of pipe, lowering in, testing, backfilling, and clean up.*

Prices for accessory work such as *resodding, repaving, bracing and shoring of trenches, abnormal rock excavation, etc.* can also be arrived at by having a number of competitive bids. With these bids plus the company's experience in such work, it is easy to arrive at prices that are acceptable to the utility and fair to the contractor.

Some observations from utility engineers concerning this type of bidding are:

> "Contractor unit prices have dropped 20% in the six years of blanket bidding, which indicates increased familiarity of contractors with the work and also the effect of competition between contractors.
>
> "It is advisable to obtain separate quotations on single and double random lengths of pipe. It is also advisable to break down the jobs into length categories such as less than 1000 ft; 1000 to 1999 ft; 2000 to 2999 ft, and over 3000 ft. With other factors being equal, the longer the job, the less the unit cost should be.
>
> "Specifications are reprinted each year, which allows the utility an opportunity to strengthen the wording and close loopholes. They may be changed during the year by addendum but this allows the contractor to change his quotations."

2. Lump Sum Bids. This type of bid requires a contractor to quote a fixed amount, but specifications for the job must be prepared in such a way to preclude the need for "extra" payments for the unforeseen. Bidding of this type may be more costly, as the contractor tends to protect himself by the inclusion of a contingency to cover the unknowns he might encounter.

3. Time and Material Bids. For this type of bidding, a contractor should furnish rates to be charged for men, equipment, material, overheads, and profit percentage. Care must be exercised by the company to prevent the use of excessive numbers of men and equipment that would result in high total cost. This is difficult to do without leaving the company open to possible criticism by the contractor for denying him the use of adequate labor and materials to efficiently perform his work.

4. Time and Material Bids Not to Exceed a Fixed Amount. This type of bidding is similar to straight *Time and Material bidding* except that it provides a maximum payment. This tends to prevent the use of excessive numbers of men and equipment by the contractor and places responsibility for productivity on the contractor to a greater extent than under a straight *Time and Material Contract.*

Contract Awards

After receipt and comparison of quotations, the contract is normally awarded to the lowest bidder since it is assumed that invitations are sent only to reputable and qualified contractors. However, the job may be awarded to other than the lowest bidder if interim developments indicate the inability of the lowest bidder to complete the project on time due to other commitments.

Inspection

It is most advisable to have a distribution company engineer or field inspector, usually from the engineering or construction department, assigned to the job to assure that the contractor performs his operations in accordance with the provisions of the contract and specifications. In doing this the company inspector must scrupulously refrain from telling the contractor **how** to do his work since this tends to relieve the contractor of his responsibilities.

The following are areas in which the company inspector should have responsibility:

1. Materials. Where materials are supplied by the utility, the company inspector should order their delivery and obtain a receipt from the contractor, who then becomes responsible for them. The company, however, should remain responsible for any defective materials and any expense involved in their replacement. Where materials are supplied by the contractor, the company has no responsibility until completion and acceptance of the work.

2. Supervision. The company inspector must be sure that the contractor provides skilled supervision during all phases of the work.

3. Alterations and Extra Work. The contractor is not allowed to make changes in the specifications or to do extra work without specific approval from the inspector. This may or may not be in writing but the latter avoids reliance on people's memory when final settlement of costs are made.

4. Permits and Regulations. The company or contractor may be required to obtain permits, licenses and easements but the inspector must see that the contractor abides by their provisions. Safety regulations should be established by the company as any accident will reflect on the company, since the public generally considers that gas main construction is being done by the local utility.

5. Inspection of Work During Construction. The company specifications should provide for a check of the welders' performance, using X-ray or radiography. Sample welds may

PROPOSAL FORM FOR ACCESSORY WORK
In Connection With Gas Mains and Service Installations

	Blanket Bids	
	Unit	Unit Price
1. Removal of Improved Paving		
1.1 Macadam (all thicknesses)	SY	
1.2 Concrete alleys and driveways (6″ or less)	SY	
1.3 Reinforced concrete roadway (9″ or less)	SY	
1.4 Sheet asphalt on concrete (3″ on 9″ or less)	SY	
1.5 Concrete roadways (9″ to 6″)	SY	
1.6 Cement sidewalk	SY	
2. Excavation		
2.1 Extra excavation—machine	CY	
2.2 Extra excavation — hand	CY	
2.3 Allowance for hand excavation over and above contractor's existing prices for machine excavation work		
Size		
¾″ to 2″ dia.	lf	
3″ and 4″ dia.	lf	
6″ and 8″ dia.	lf	
10″ and 12″ dia.	lf	
16″ dia.	lf	
20″ dia.	lf	
24″ dia.	lf	
2.4 Rock excavation—including removal of refuse and replacement with select backfill where necessary	CY	
2.5 Shoring and bracing, left-in-place	mbf	

	Blanket Bids	
	Unit	Unit Price
3. Appurtenances and Miscellaneous		
3.1 Stringing pipe along trench sites — all sizes	lf	
3.2 Installation of anodes	No.	
3.3 Installing risers in non-basement homes when the service pipe is taken through the wall to the inside of the house — all sizes	No.	
3.4 Welding Van-Stone flange and nipples on 5-ft piece of pipe for company connection at valves —2″ and 3″ sizes	No.	
4. Backfilling		
4.1 Air ramming—6″ layers	SY	
4.2 Dry washed sand—in place	Ton	
4.3 Crushed stone—in place	Ton	
4.4 Bank run gravel—in place	Ton	
4.5 Bank run sand—in place	Ton	
4.6 Top soil—in place	Ton	
5. Restoration of Paving, etc.		
5.1 Replace sod	SY	
5.2 Fertilize and seed	SY	
5.3 Fertilize, seed and mulch	SY	
5.4 Temporary paving	SY	
5.5 Reinforced concrete paving — 9″ thick	SY	
5.6 Concrete paving base—per 1″ thick	SY	
5.7 Cement walks—5″ thick	SY	

NOTE: Company Inspectors or Engineers will be the determining persons as to whether or not a particular job requires that a pipe be driven or bored. If boring is required and the contractor does not have the equipment available, but prefers instead to drive the next larger size pipe, remove the pipe and install the mill-wrapped pipe, the contractor is to use the prices for boring predicated on the actual size of the carrying pipe being installed. In this case, the contractor must furnished the pipe used for driving.

Driving only is normally required when it is desired to leave the casing pipe in place as a sleeve.

be removed for testing and if approved, paid for by the company, while the contractor should pay for any rejected welds. The number of welds tested usually depends upon the size of the main and the type of service for which it is designed.

The contractor should be required to check pipe coating with "holiday" detectors and to repair the coating flaws at his own expense, except that the company may pay for the repair of excessive damage caused by poor mill coating or by improper handling by the company during delivery of the pipe to the contractor.

The inspector should witness the testing of the installation and specifications should require the contractor to repair any defects at his own expense.

6. Correction of Work After Final Payment. Normally, provisions are made for the contractor to remedy any defects that appear within a specified time limit. The shorter this time limit, the less the contractor will provide under contingencies to cover the work. Normally, 60 days is considered the minimum to obtain sufficient backfill compaction for the use of a Pearson-type "holiday" detector to pick up coating flaws. The contractor should be required to repair any flaws at his own expense. A longer time is desirable to check workmanship involving paving, sodding, and reseeding. A one-year limit here allows for the elements of all seasons to take effect.

There are other factors controlling construction by contractors, such as performance bonds, provisions for the contractor to indemnify the company against all damages and expense as a result of his operations, provisions for the company to take over and complete work upon default by the contractor, and the company's right to control the use of subcontractors.

This, of course, brings us back to the beginning, that proper preparation of contracts and specifications is an essential that must be carefully thought out.

With adequate and clearly worded contracts and specifications and with a conscientious and effective effort made by the company inspector to maintain good cooperation between the contractor and the company, the use of contractors to level out the utilities' construction work can and will be adequately controlled.

This should be to the advantage of both the contractor and the utility company.

Acknowledgment

This article adapted from a presentation made at the 1960 A.G.A. Operating Section Distribution and Transmission Conference, New Orleans, Louisiana.

	Blanket Bids	
	Unit	Unit Price
5.8 Tar and chip paving-- 1" to 2" thick		
less than 50 SYS	SY	
50 to 99 SYS	SY	
100 to 149 SYS	SY	
150 SYS and over	SY	
5.9 Tar and chip paving for lap sealing trenches		
less than 50 SYS	SY	
50 to 99 SYS	SY	
100 to 149 SYS	SY	
150 SYS and over	SY	
5.10 Macadam paving—4" thick and under		
less than 50 SYS— per 1" thickness	SY	
50 to 99 SYS — per 1" thickness	SY	
100 to 149 SYS — per 1" thickness	SY	
150 SYS and over — per 1" thickness	SY	
5.11 Macadam paving — over 4" thick		
less than 50 SYS — per 1" thickness	SY	
50 to 99 SYS — per 1" thickness	SY	
100 to 149 SYS — per 1" thickness	SY	
150 SYS and over — per 1" thickness	SY	

	Blanket Bids	
	Unit	Unit Price
5.12 Penetration Macadam — 8" county specification		
less than 50 SYS	SY	
50 to 99 SYS	SY	
100 to 149 SYS	SY	
150 SYS and over	SY	
5.13 Specification "B" Hot Mix Topping		
less than 50 SYS — per 1" thickness	SY	
50 to 99 SYS — per 1" thickness	SY	
100 to 149 SYS — per 1" thickness	SY	
150 SYS and over — per 1" thickness	SY	

6. Pipe Boring

Size	First 30 ft	Over 30 ft
¾" to 2½" dia.	_____ per ft.	_____
3" to 6" dia.	_____ per ft.	_____
8" to 10" dia.	_____ per ft.	_____
12" dia.	_____ per ft.	_____
16" dia.	_____ per ft.	_____
20" dia.	_____ per ft.	_____
24" dia.	_____ per ft.	_____

7. Pipe Driving

¾" to 2½" dia.	_____ per ft.	_____
3" to 6" dia.	_____ per ft.	_____
8" to 10" dia.	_____ per ft.	_____
12" dia.	_____ per ft.	_____
16" dia.	_____ per ft.	_____
20" dia.	_____ per ft.	_____
24" dia.	_____ per ft.	_____
26" dia.	_____ per ft.	_____
30" dia.	_____ per ft.	_____

The prices for boring and driving include the cost of installing the carrier pipe in the sleeve or augered hole. They also include the cost of preparing the driving or boring pit, including sheathing, if required, for depths of cover on the main to 4 ft. Attempted bores and drives will be paid for at the same rate as completed bores and drives; however, casing installed by open cut will be paid for at the prices set for installing main of the same size as the casing. In this instance, the carrier pipe will be paid for at the prices set for installing main by machine excavation only.

Transistorized Two-Way Mobile Radio Equipment

Lower maintenance costs, lower operating costs, greater reliability, and greater utilization more than offset the additional cost of the newest in mobile radio gear for gas utility operations

Transistorized radio is installed in this gas company vehicle.

Bruce W. Conover, *Manager of Operations*
South Jersey Gas Company, Atlantic City, New Jersey

TWO-WAY MOBILE RADIO COMMUNICATIONS have become an important part of gas distribution operations in providing better customer service and achieving greater operational efficiency.

In the nearly 20 years that have elapsed since utilities discovered the value of radio communications, utility use of two-way radio has grown tremendously. Latest Federal Communications Commission figures show that more than 125,000 transmitters are now authorized for operation in the power radio service — the service in which most gas utility equipment is licensed.

Dispatch desk at South Jersey Gas Company's Glassboro office.

Our company, South Jersey Gas Company, is licensed in this group of frequencies. We have been using two-way radio since 1945 and are presently engaged in a system expansion program, using the recently introduced transistorized mobile radios in this expansion.

Transistorized equipment, of course, is the latest development. As a bit of side information, it should be noted that — in the development of two-way radio — a major improvement or change seems to be realized about every five years in mobile equipment.

In 1939, the first practical FM radios were introduced, replacing the older AM gear. Around 1944 or 1945, the first major break in FCC licensing relaxations took place. System authorizations became easier at this time for many industries.

In 1949, the first channel splitting occurred. Also in 1949, the first effort was made to increase the number of available channels, by narrowing band width. At this time deviation limits of plus or minus 15 kilocycles were set.

In 1954, the 12 volt automobile electrical systems were introduced, so a need for 6 or 12 volt radios developed. In 1959, we experienced channel splitting and the first extensive use of transistors in mobile radio equipment.

Before describing South Jersey's experience with these radios, some pertinent background about the gas company is necessary:

We are a distributing company serving a 2000 square mile area in the southern part of New Jersey, including Atlantic City. Our territory extends from the Atlantic Ocean to the Delaware River, and the total population of the area in 1959 was estimated at 500,000. We presently serve approximately 90,000 customers with more than 60,000,000 cu ft of gas per day. There are 79 municipalities in our area of operation.

Our territory has been divided into three operating divisions, with headquarters at Pleasantville, which is just outside of Atlantic City; at Glassboro, which is near Camden, and at Millville, which is approximately in the middle of the southern half of our territory.

NEXT STOP... BAY BOTTOM!

American Molox Ball Joint Pipe Specified for Gas Installation

"Our experience with underwater installations caused us to select Cast Iron Pipe . . . AMERICAN Molox Ball Joint pipe," says one distribution engineer for an outstanding West Coast gas utility. The above view shows workmen assembling 10" AMERICAN Molox Ball Joint pipe on board the construction barge, part of a 3,500-foot underwater gas supply line. The 96-foot sections were lowered with the aid of a strongback for assembly beneath the surface.

Specify rugged AMERICAN Molox Ball Joint pipe for river crossings and other difficult underwater installations. Molox pipe affords maximum installation economies because it is easily adapted to several installation methods: It can be floated or pulled across streams, or can be installed directly on the bottom from a barge. Once laid, it remains bottle-tight at any angle. The joint is designed for deflections up to 15°.

Before "plunging" into underwater pipe installations, consider these and many other advantages of AMERICAN Molox Ball Joint pipe. Write for free illustrated catalog.

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SALES OFFICES: Chicago
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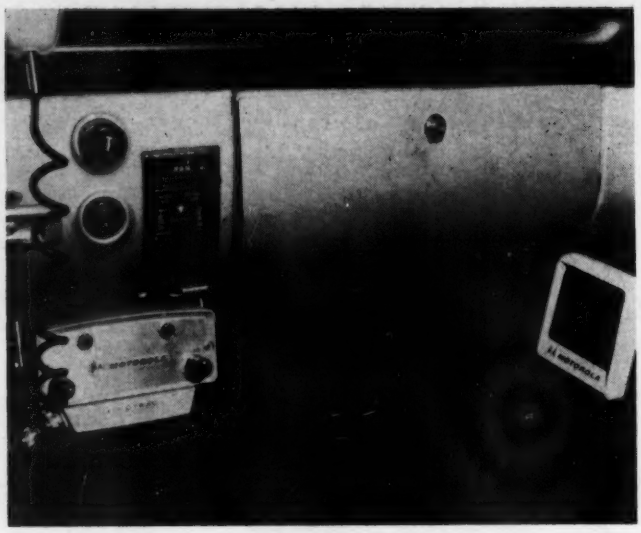


Control head, speaker and microphones are mounted in this fashion by South Jersey Gas Company.

Transistorized radio is mounted in this fashion on floor of utility truck. Seat fits over top of unit.

Our radio network is centered around base stations at these three headquarters. All operate on the same frequency. A total of 71 radio equipped vehicles are utilized in our construction, service, and administrative activities. Presently, we plan to equip about 110 of the 146 vehicles we operate. This would provide 100 percent coverage of our service and street trucks.

We began using radio in the mid-1940's and have always appreciated its value, but as any of you with radio experience know, there have been certain problems contingent with radio operations. With no disparagement of equipment intended, we know that two-way mobile radios have not been the most reliable type of electronic equipment manufactured. They have been hard on vehicle batteries, especially in the winter time, and they have been rather large and bulky instruments. While we have always managed to successfully put up with these problems, a solution to them would have been appreciated for a very long time.

Advent of Transistors

The first glimmer of hope for a quick solution to the problems came in 1948 when the Bell Telephone Laboratories announced the invention of transistors. From 1948 to 1956 we saw utilization of this new miracle component in such electronic devices as portable AM radios, hearing aids, military equipment. Because of the severe operating requirements of industrial electronics, the transistor did not make an appearance in two-way mobile radios until 1957. Then, its use was quite limited to a few circuits. In August 1958, one manufacturer introduced the first two-way radio which made extensive use of the new semi-conductors. This was the Motorola MOTRAC radio, which has a completely transistorized receiver, a completely transistorized power supply, and a partially transistorized transmitter.

We installed our first 13 transistorized units in July of 1959.

To give you a comparison of the difference in size Fig. 1 shows a transistorized unit standing beside an older tube type radio. The small assortment of transistors in front of the transistorized radio performs the same work as does the pile of tubes and other components in front of the older equipment.

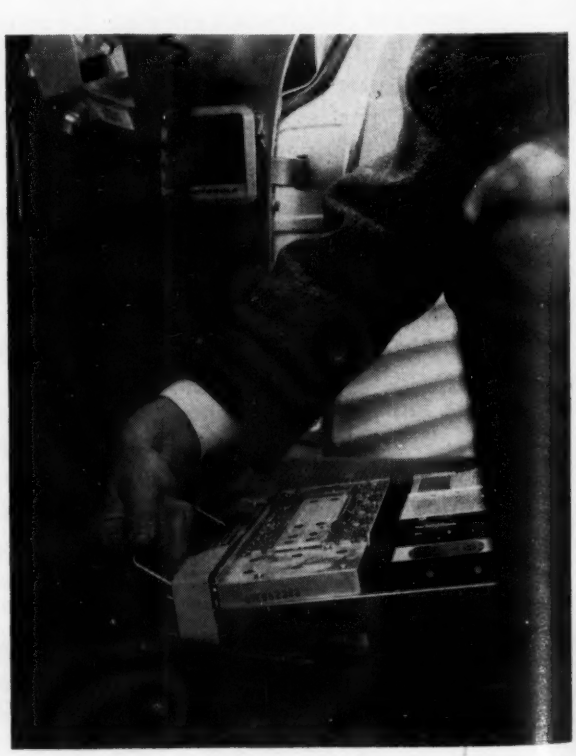
Fig. 2 shows the transistorized radio outside of its housing. The front chassis is the fully transistorized receiver. The middle chassis is the power supply. Note the absence of troublesome vibrators in this equipment. The last chassis is the transmitter. The black fin device on the rear of this unit is a heat radiator that completely envelopes the transmitter final amplifier stage. This technique of dissipating heat by a radiation method enables the unit to be completely sealed, yet maintains a low, ambient temperature. A metal friction device transfers heat directly from the tube envelope to the radiator.

Working Experience

The first difference we noticed about the transistorized radio was its ease of installation. The unit is mounted on the vehicle's floor board beneath the front seat. Its vertical slimness enables the unit to be easily installed in this position.

An accompanying photo illustrates how the radio portion of the equipment can be pulled from its drawer housing when the seat is in place over the equipment.

Perhaps this benefit of compactness can be over-rated,



Radio unit can be pulled out of drawer housing for maintenance purposes.

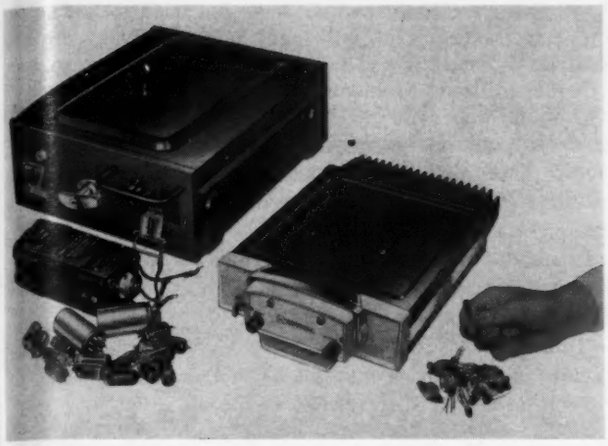


Fig. 1. Transistorized unit (right) is much smaller than standard tube-type unit (left). Note difference in number and size of component parts.

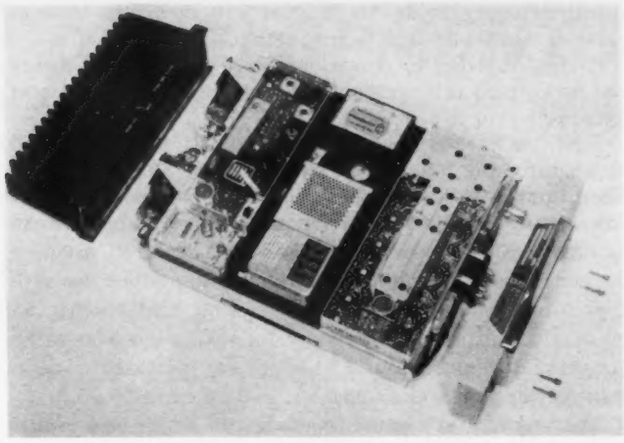


Fig. 2. Transistorized unit outside its housing. Front chassis is fully transistorized receiver. Middle chassis is power supply. Rear chassis is transmitter. Black fin device at rear is heat radiator that envelopes final amplifier stage of transmitter.

but we think not. It puts the radio equipment completely out of the way and eliminates need for external weather-proof housings. Elimination of this cost helps justify the added initial expense of the new equipment.

The new transistorized mobile radios are priced approximately one-third higher than tube-type radios of comparable power. While this cost factor may hurt in the beginning, it does balance out in favor of the user over the life of the set because of deduction in other expenses, such as maintenance, operation and installation. Elimination of a weatherproof housing is one of these. The housing, cable routing, weatherproofing, and housing installation added from $50 to $150 to the cost in the past.

Lower Maintenance Costs

Most apparent tangible operational expense reduction of the transistorized radio is its reduced maintenance cost. Contract maintenance rates charged by the manufacturer are about 10 percent lower for the new transistorized equipment than for vibrator-tube radios over the life of the set. Using an average representative monthly contract maintenance rate of $8 for tube type equipment we can approximate a savings of 80 cents per month, or $9.60 per year.

Over an eight-year life span, this amounts to about $75, which again helps make up the initial cost differential. Lower maintenance rates can only be provided if equipment is more reliable. The added responsibility of transistorized radios is of great importance to any utility. We cannot afford to have our vehicles lose communications at a time when they may be required.

We have also found that we can use the transistorized radios in the fringe areas of our system and experience far better communications between truck and base station than is possible with our older radios.

From this point on, very frankly, I am mixing typical figures for savings with those gained from our own experience with transistorized radios. With approximately one year's experience with 13 transistorized units, we have realized some of these savings, but our backup figures are not complete at this point.

Operating Cost Savings

Other benefits of transistorized radios result from their low current drain characteristics. Transistor circuits, mainly because of the absence of filaments to heat, do not consume as much power as do vacuum tube circuits. In the transistorized radios, battery drain when the unit is on standby is less than one ampere — about 85 percent less than drain of a tube type set.

Translating lower power drain characteristics into monetary values can be tricky, but let's try it. First of all, it costs money to generate power. A conventional radio, drawing about 7.9 amps on standby for 7 hours a day from a 12.6 volt source consumes about 697 watt hours of power per day. If we could purchase this power at 3 cents per kilowatt hour, it would cost about $5.52 per year per mobile radio.

The transistorized radios, however, draw but 0.75-amp and consume but 66 watt hours per day. Total cost per year is 51 cents.

This alone would be a savings in operating costs of approximately $5 per year. As the gasoline engine in a vehicle is hardly an efficient power generator, however, it would cost us at least twice as much to generate this power as it does a power utility. Consequently, we feel that we save more than $10 per year, per mobile unit, in gasoline costs. This savings is very real. You do not get power for nothing. You must expend some other commodity. In the case of a vehicle, it is gasoline. The generator does not require as much driving force when the load is light.

There is still another gasoline savings independent of this one. Formerly, when one of our vehicles was parked at a construction site, it was necessary to idle the engine in order to maintain a charged battery if the radio were left on for monitoring purposes.

The low power consumed by the transistorized radio eliminates the need to idle the engine. We know that it takes from ½ to ¾-gal of gasoline per hour to idle a perfectly tuned engine.

By eliminating one hour of vehicle idling per day, we have saved approximately $60 annually in gasoline expenses. Idling, of course, is very abusive to vehicle engines. An hour's idling is equivalent to at least 30 miles of driving. In a year's time (264 working days) an hour of idling per day is equivalent to almost 8000 miles on the speedometer. A normal engine overhauling occurs every 75,000 miles. By eliminating this 8000 miles in idling time, you can save 10 percent on overhaul costs, or approximately $5 a year.

Transistorized radios also eliminate need for special generators or alternators. This could amount to as much as $20 per year if a heavy duty alternator costing $170 were required. Let us say, however, that we eliminate only a lower cost special generator, which saves us about $6 per year over the life of the set.

Besides these benefits, we feel that the installation of tran-

sistorized sets provides us at least $50 in higher trade-in value at the end of an 8 year life span.

Adding together these various costs will allow us to see just how much this premium price radio actually will cost over the 8 year life of the set.

First, we have eliminated approximately $75 for special weatherproofing housing, or over 8 years, $9.30 per year. Then, our 10 percent reduction in maintenance rates amounts to $9.60 per year. We are saving $10 per year in gasoline costs because of lower power required to drive the generator. By eliminating an hour's idling time, we save approximately $60 per year on gasoline, and another $5 on overhaul expenses. The generator saving amounts to $6 per year. Add to this our $50 bonus for increased trade-in value divided by 8 years and we have an extra $6.30.

This amounts to a grand total of $106.20 per year reduction in radio maintenance and operating cost. Over an 8 year period, this means $848.00

Since our premium price units cost us about $300 more than tube type equipment, you can say that we are about $548 ahead per unit, and we have not tried to add in the monetary value for improvement in reliability in terms of positive aid it might give us in solving an emergency or other operational problems.

Another benefit of the transistorized radio much appreciated by our operating personnel has been the increased audio power delivered by the new sets. A full 5 watts is boomed out of the speakers, making it easy to catch all messages even in the fringe parts of our territory. The efficiency of design in these new radios is so good that our dispatcher is able to pick out the transistorized radios from the other equipments on our system.

In summary, South Jersey Gas Company is extremely pleased with its new equipment. In fact, we are planning further purchases of transistorized mobile radios.

Acknowledgment

This article adapted from a presentation by the author at the American Institute of Electrical Engineers Summer Session, Atlantic City, New Jersey, June 19-24. * * *

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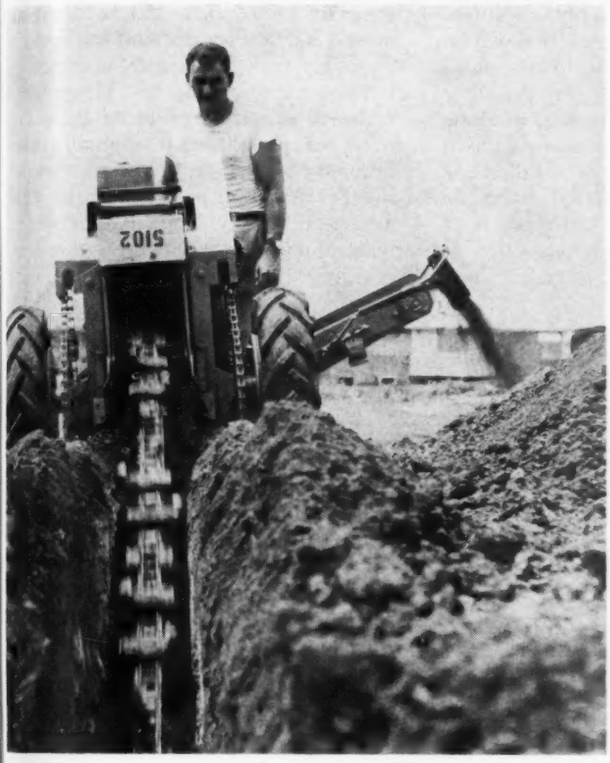
DISTRIBUTION DEVELOPMENTS

NEWS ABOUT CURRENT AND PLANNED CONSTRUCTION



Laclede Gas Company finds small trencher helps its construction crews keep pace with the demands of new business and installation of new gas service lines. More than 1030 new services were installed during the month of May — a new record for this time of year.

Rochester Gas and Electric Corporation, Rochester, New York, has budgeted approximately $7,800,000 for gas projects in 1960. Last year construction of new gas facilities amounted to $7,239,000. Although expenses for relocation of gas services due to continued construction of Rochester's Inner and Outer Loop highway systems were sizeable, major portion of gas construction costs were for additional distribution services and improvements. Approximately 3269 new customers were added to system and 2518 customers' appliances were converted from reformed or mixed gas to use of straight natural gas. By year's end 85,581 customers were being supplied natural gas, and 67,828 customers in the central part of Rochester were supplied from units that reform natural gas before distribution. RG&E's gas franchise area was considerably increased during 1959. In the Lake Shore district, east of Rochester, franchises were received to serve gas in 118 sq miles of the Town and Village of Sodus and in Marion. Mains were extended into those areas from Williamson to serve the residents. South of Rochester, gas mains were installed to serve customers in another new 25 sq mile franchise area in Victor. West of Rochester, company purchased the system of Churchville Oil and Natural Gas Co. and the Bergen property from The Pavilion Natural Gas Co. These purchases added 81 sq miles of new gas service area. Further expansion of gas service into new franchise territory are anticipated during 1960.

Winnebago Natural Gas Corporation, Kaukaukauna, Wisconsin, has PSC "green light" to build a $4,000,000 natural gas distribution system to the 15 communities of Clintonville, Embarrass, Weyauwega, Gillett, Oconto Falls, New London, Seymour, Bear Creek, Hortonville, Columbus, Fall River, Shawano, Bonduel, Sun Prairie, and Waterloo.

Wisconsin Power and Light Company, Madison, Wisconsin, has applied to the PSC for authority to install a $165,000 gas distribution system in Juneau. Plans call for serving 51 customers at first, and 700 eventually.

Milwaukee Gas Light Company, Milwaukee, Wisconsin, has secured a natural gas franchise from the city of New Lisbon and is currently making preliminary plans to connect the area.

Northern Indiana Public Service Gas Company, Hammond, Indiana, has secured gas franchises in Medaryville, Ogden Dunes, and St. John. Petitions are now before the communities of Knox, Hebron, La Crosse, and Lowell to serve them with natural gas. Construction has been completed on new gas distribution systems in North Judson, Mentone, and Etna Green, and is underway in Bristol, Fowler, Francesville, LaGrange, Monon, Milford, Walkerton, and Wakarusa.

South Georgia Natural Gas Company, Thomasville, Georgia, has construction underway on 108 miles of 3, 4, 6-in. lines through Tifton and on to Fitzgerald, Georgia. Contractor is Louisiana-Mississippi of Georgia. Company currently seeks FPC approval of a $550,451 project to serve Sylvester and Ocilla, Georgia. Proposal involves a $16,408, 1.4-mile, 3½-in. lateral and $272,000 distribution system in Sylvester, and a $4,943 lateral to Oscilla and $245,000 city distribution system.

City of Perrysville, Missouri, has awarded the contract for installation of 16 miles of 4 and 6-in. distribution lines to H. C. Price Co. Construction is underway.

City of Bethany, Missouri, has construction underway on an undetermined amount of distribution lines in the city. Contractor is Panama Williams Corp. of Houston, Texas.

Iowa Power & Light Company, Des Moines, Iowa, plans to spend approximately $450,279 to build short lateral lines to Natural Gas Pipeline Company's main transmission line and to install distribution systems in Milo, Dallas, and Melcher, Iowa.

Carolina Pipeline Company, Columbia, South Carolina, plans to build distribution systems in Bethene, Conway, Georgetown, Myrtle Beach and Winnsboro, South Carolina, and an 85-mile 8-in. supply line from Southern Natural Gas Company's Aiken line to near Camden, South Carolina. Company also plans to install a line between Florence and Marion, South Carolina, to serve a new DuPont plant now under construction. Total cost of these projects is estimated at $6,925,000.

Southern Union Gas Company, Dallas, Texas, has construction underway in Austin, Texas, on a $220,000 project involving installation of 15,000 ft of 16-in. line—including a crossing of the Colorado River — to deliver gas from United Gas Pipe Line Company's transmission system to the new municipally-owned Holly Street electric generating plant. During the summer, United will install $1,500,000 in additional facilities, including 22 miles of 20-in. loop line, to increase its delivery from 91,000,000 to 115,000,000 cu ft of gas daily to Southern Union for consumers in the city — including the power plants. Initial unit being installed at the new Austin electric generating plant has a rated capacity of 125,000 kilowatts and is expected to use approximately 1,000,000 cu ft of gas per hour. The West First Street generating plant in Austin currently requires approximately 1,500,000 cu ft of gas per peak hour but beginning of the Holly Street unit's full-capacity operations will cut this load slightly.

The Connecticut Power & Light Company, Berlin, Connecticut, converted six cities to straight natural gas during 1959 — Windsor, East Windsor, Locks, Suffield, Enfield, and Thompsonville. This was another step in a long-range program to convert entire system to straight natural gas. An alternate natural gas supply line running from the Massachusetts state line to Thompsonville was added. In addition to providing alternate supply for Northern division customers, new line will be used to power the gas turbine generators at Thompsonville during the summer months. In Norwalk, five propane gas storage tanks and new equipment for handling LP-gas were installed. At Waterbury, five additional propane storage tanks, and a 750 Mcf per hour gas booster were put into operation to provide adequate supply of gas for peak load periods.

Fitchburg Gas and Electric Light Company, Boston, Massachusetts, plans to extend natural gas mains and service lines to a part of Lunenburg, newly-franchised and contiguous to its present operating area in Fitchburg.

Citizens Utilities Company, Stamford, Connecticut, has extended the natural gas lines of its Colorado properties to serve new customers in the Industrial Park and Air Base region near La Junta. Project involved approximately five miles of 5-in. line installed at an estimated cost of $130,000.

Arizona Public Service Company, Phoenix, Arizona, spent more than $1,700,000 for new distribution mains, $1,400,000 for new customer service lines, and another $1,000,000 for meters and regulators last year. Launching of the new gas irrigation program *(AGJ July '59)* required almost $700,000 for distribution systems to supply fuel to company-operated irrigation pumping engines. This project included purchase of more than 110 miles of pipe, largest shipment ever ordered by the company. Extension of the gas irrigation program to the rural area near Aguila made it practical to provide natural gas service to this community. The Gila Bend gas distribution system, begun the latter part of 1958, was completed, and a gas system serving the new town of Kearny was also completed. Another addition was made to the area with the initial gas distribution lines installed at Sun City, about 12 miles northwest of Phoenix.

Portsmouth Gas Company, Richmond, Virginia, completed in 1959 construction projects totaling $322,800. Included was installation of 106,669 ft of 3-in. equivalent gas mains to the Portsmouth Naval Hospital and several new housing developments in the Portsmouth area. Yearly sales of natural gas rose 7 percent to 1,511,057,000 cu ft.

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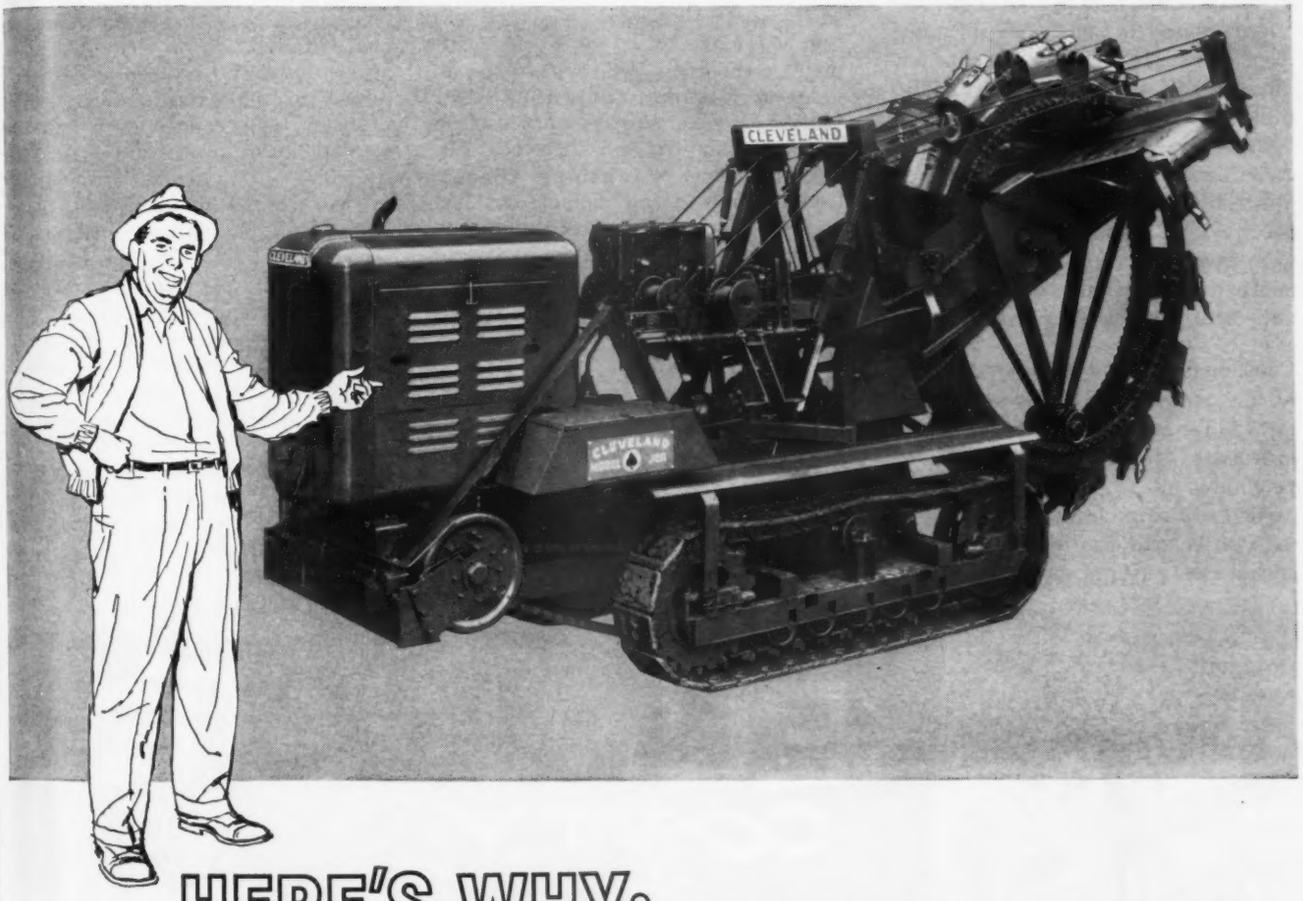

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Distribution Developments

Virginia Electric and Power Company, Norfolk, Virginia, has been granted a franchise to extend its lines east from Norfolk to serve the fast growing suburban area between that city and Virginia Beach. This new territory is larger than that presently supplied by company's Norfolk district and will expand its service area to include all of Princess Anne County. During 1959 approximately 147 miles of 3-in. equivalent new gas mains, services, and other plant improvements were installed at an estimated cost of $4,432,000. Company plans a 1960 extension of its line west to connect with a new 8-in. lateral across the James River proposed by Commonwealth Natural Gas Company. New lateral will run approximately 15 miles upstream from an existing lateral.

Consumers Power Company, Jackson, Michigan, spent more than $1,733,000 in 1959 for expansion of its gas system in Outstate Michigan. Construction expenditures of $5,300,000 had to be carried over into 1960 because of the steel strike and shortage of large-diameter steel pipe prevented completion of the two major pipeline projects. One, a 26-in. 122 mile long line receives deliveries from Trunkline Gas Co. at the Michigan-Indiana border near White Pigeon in the southwestern part of Michigan and transports the gas to the company's Northville compressor station in the suburban Detroit area. The other line, a 23 mile, 24-in. line, runs from Northville to a junction with other major pipelines near Clarkston north of Pontiac. In 1959, a 24-in. line from the Overisel gas field near Holland, Michigan to Woodbury, west of Lansing, was extended 40 miles to join the main north-south gas supply lines at Laingsburg, northeast of Lansing. Also, last year the company purchased most of the working interests in a new gas field in Salem Township, Allegan County, only a few miles from the Overisel field. A connecting line will be built in 1960 from Salem to Overisel, and company expects to use both fields for gas storage at some future date. Majority interests in the Evart gas field in Osceola County, 25 miles southeast of Cadillac, were also acquired last year. Already out of production for a few years, this field was purchased for future use as a storage field; it lies about 16 miles from the Muskegon River compressor station operated by consumer's subsidiary, Michigan Gas Storage Co.

Bridgeport Gas Company, Bridgeport, Connecticut, recently completed a $40,000 project involving installation of 5200 ft of mains and services in Westport. Approximately 811 ft of 12-in. and 4389 ft of 6-in. steel line were installed on Boston Post Road, from Hull's Highway, near Southport, west to Sasco River Bridge at Southport-Westport line, then west to point beyond Maple Avenue in Westport. The Boston Post Road to Westport route will eventually have a 6-in. steel main on each side as there is high commercial concentration on the road. Company also installed during 1959 a $200,000 project in Trumbull involving 13,000 ft of 12-in. main connecting a new city gate station to an existing distribution system. The line extends from Broadbridge Avenue in Bridgeport along Huntington Turnpike to Primrose Drive in Nichols section of Trumbull. This new line opened a fast growing area never served with gas before. Also completed is a $30,000 project in Trumbull involving 5000 ft of 6-in. main to an area where several new housing developments will start in 1960. The line runs from White Plains Road north along Daniels Farm Road to a point just south of Wordin's Lane. Contractor on all three projects was Harrelson Construction Company of Seymour.

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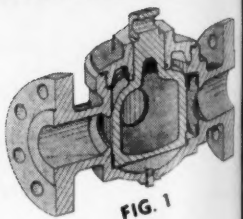

FIG. 1

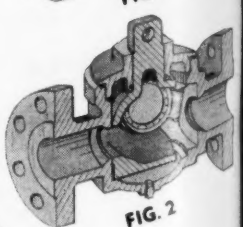

FIG. 2

The PLUGAROO combination Plug and Check Valve eliminates expensive lubricating equipment . . . reduces costly maintenance trips. Fig. 1—A quarter turn closes the plug against clapper for positive seal, yet wide tolerances prevent plug or valve-body gauling. Fig. 2—In "open" position, the 20° vertically hinged clapper seals under its own weight and the PLUGAROO operates as a Synthetic Seal Check Valve. Plug locking device is optional on your request. The PLUGAROO is available in semi-steel, steel, and aluminum-bronze thru series 90 (2160# W.P.—3250# Test). API, ASA dimensions for all standard end connections. For details, write:

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CIRCLE (1) ON THE REPLY CARD

Gas Cutting Torch features a built-in control system designed to eliminate flashbacks. Injection-type mixing chamber and valve system provides controlled steady application of oxygen and prevents "jumps" thus assuring accurate uniform cutting action. Lightweight torch cuts steel up to 15-in. thick, and works equally well with all types of fuel gases, including low pressure natural, propane, and acetylene. Available with either 70 or 90 deg head.

CIRCLE (2) ON THE REPLY CARD

The Cheerful Gas Light. Miniature portable gas lamp operates on pressurized cans of LPG; has a soft gas flame, no mantle, that can be adjusted to any height. Provides 50 hours of soft light on one can of fuel. Is sootless, greaseless, smokeless, windproof, and does not require any wires or connections.

CIRCLE (3) ON THE REPLY CARD

New visible tab card, Magne-Tab, has an exclusive patented feature that permits faster finding and filing of tab cards. Each card has a permanent built-in magnetic action that causes cards to repel each other at the touch of a finger. Twenty or more cards fan-out automatically in file trays at any point of reference, exposing top edges of all 20 cards instantly. Cards can be used in present automatic sorting and punching machines without modifying equipment; function exactly like conventional tab cards when placed into any automatic machinery.

CIRCLE (4) ON THE REPLY CARD

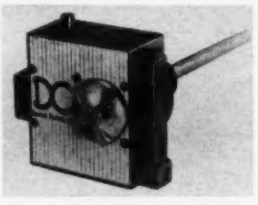
Brilliant Red synthetic primer for coal-tar enamels, to be marketed under trade name of "Reilly Redhead," dries to touch within 10 minutes when applied, by brush or spray, to clean metal surfaces at rate of 500 to 800 sq ft per gal when the atmosphere is about 70 deg, relatively dry, and free from organic solvent vapors. Under the same conditions, new primer will dry to accept enamel within 2 hours. Initial bond strengths are up to several times greater than typical non-synthetic primers, and fractionally greater than other Reilly primers, X-1 and X-10.

CIRCLE (5) ON THE REPLY CARD

Economical gas heating of residential and commercial swimming pools is combined with sand and gravel filtration in new combination pool filter-heater, manufactured by Laurel Filter Division of Lovekin Water Heater Co. Unit requires no more space than conventional filtering systems. Warms and filters all of the water passing through the unit, instead of raising part of the water to a high temperature. With lower heat input and longer heating cycles, no water is heated above 90 deg and lime and scale are eliminated. Equipped with completely automatic A.G.A. listed controls.

CIRCLE (6) ON THE REPLY CARD

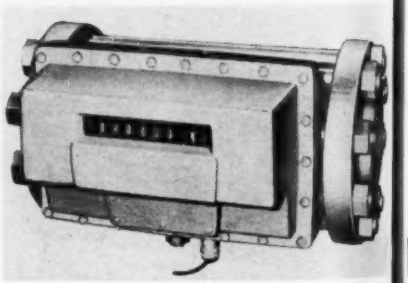
Deutsch Controls Corporation's newly-designed gas water heater control incorporates 100 percent safety shutoff, non-displaceable gas cock, and a universal filter. Is easily installed using the same main burner and pilot tubing as required by other controls. Pilot and main burner adjustments are located on top of the Deutsch control body for convenient accessibility.



CIRCLE (7) ON THE REPLY CARD

Cold-Applied Coal-Tar Protective Coatings are described in new 13-page illustrated booklet published by Allied Chemical Corporation's Plastics and Coal Chemicals Division. Booklet lists detailed specifications, resistance properties, and typical uses.

CIRCLE (8) ON THE REPLY CARD



Mass flowmeter for natural gas, now being marketed by BS&B makes possible the measurement of gas directly in pounds, eliminating calculations for conversion of volume to weight. Use of the new instrument should substantially cut costs of computing operations required in measurement by volume. The device — sensing mass directly — requires no in-between calculations, is completely self-contained, weighs only 100 lb, and is designed for long maintenance free operation. Unit can be designed into remote controlled systems with electrical pulses, each representing a given rate of flow, operating remote recording, dispatching and accounting systems.

CIRCLE (9) ON THE REPLY CARD

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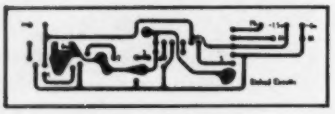
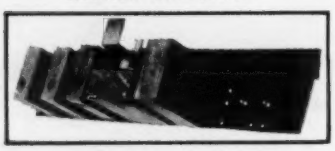
MODEL TR-1A

Utility and Construction Companies, Municipalities are unanimous in agreeing that MODEL TR-1A has proved most effective for locating mains, services, valves, conduit, high voltage lines, telephone cables. Easily separates parallel lines and can be used to trace non-metallic pipe lines. Complete piping systems traced out.

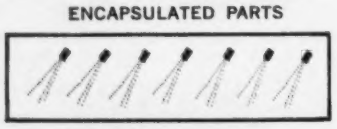
SPECIFICATIONS: Size of cases when clamped together: 9½" x 12½" x 5½" • Size of transmitter and receiver boxes, each: 9½" x 12½" x 2¾" • **Operating weight,** transmitter: 4½ lbs. • **Operating weight,** receiver: 4¾ lbs. • **Circuit:** Transmitter—one transistor, Receiver—six transistors • **Batteries:** Transmitter—4 size C flashlight cells, Receiver—4 size C flashlight cells • **Switching:** a. Automatic power switching for all "on-handle" operations. b. Automatic "turn-off" when set is not being used.



ETCHED CIRCUITRY



ENCAPSULATED PARTS



SEVEN TRANSISTORS

The COLDAK Company, Inc.

Leading Electronic Manufacturers

1933

1540 W. Glenoaks Blvd.
Glendale 1, California

MUELLER® NO-BLO®

LINE STOPPER FITTINGS

...to match any need!

■ Whatever your need, there's a Mueller quality-built No-Blo Line Stopper Fitting to fit it *exactly*. Sizes from ¾" to 12" . . . welded or mechanical joints . . . for steel, thin-wall steel or cast-iron pipe . . . with pressure ratings from 125 to 1,200 p.s.i.

Write for information on fittings you require.

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let Southern Cross account for your "unaccounted-for"

Don't let execessive unaccounted-for worry you—with SCF on the job you can r-e-l-a-x confident your leak location program will be handled efficiently and to your complete satisfaction.

Distribution executives nationwide verify that Southern Cross Foresters account for unaccounted-for, help improve profits, and raise the safety factor.

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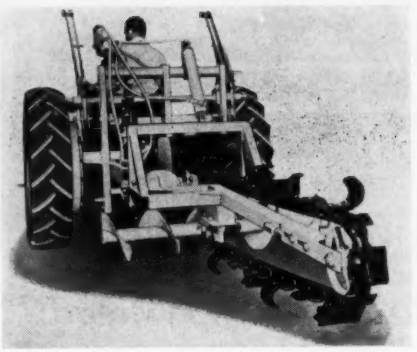


Latest model of the Vermeer Pow-R-Ditcher line of trenching machines is specifically designed to fit all 3-point tractor hitches. Built for contractors, municipalities, and utilities new model has a digging width of 6 to 16-in. and will dig to 4½ ft deep. Digging chain is same as used on the largest Vermeer ditchers. New unit has an all-new hydraulic actuated travel ratchet device that gives full control of digging speed from one control lever. Power is taken from tractor's hydraulic system.

CIRCLE (10) ON THE REPLY CARD

Extra Large Gas Lights for institutions, schools, public buildings and parks are now available from Alker Mfg. Co. of Muskogee, Oklahoma. Lanterns are made of cast aluminum parts, and the posts of street lights are made of extruded aluminum. Post or lantern-type gas lights are available in single or multiple mantle units.

CIRCLE (11) ON THE REPLY CARD

Precise integrating of flows that can be represented by a d-c electrical signal, are possible with new GPE Controls, Inc. electric integrator unit. Although designed for use with company's linear signal electric flow transmitters, instrument can be used for integrating any quantity that can be linearly represented by a d-c voltage or current signal in the 0-25 v range. Integration is continuous and accurate to within ½ of 1 percent with flow turndowns of as much as 10 to 1. Chart planimetering is eliminated by direct read-out.

CIRCLE (12) ON THE REPLY CARD

Computer device to transfer data from punched paper tape to magnetic tape is now available from IBM. Designed for organizations such as utilities who use paper tape extensively in such applications as order-processing, billing, inventory control, and engineering. Unit is first paper tape to magnetic tape converter that photoelectrically reads both chadless (punched flap) tape, and chad (punched hole) tape. Output is 200-character-per-inch Mylar magnetic tape; will convert most paper tape in use today including 5-track telegraphic code and IBM 8-track code.

CIRCLE (13) ON THE REPLY CARD

Connected with one or more safety circuit breaking instruments and installed in gas supply lines leading to burners of industrial boilers, furnaces, ovens, kilns, and other processing equipment, the new Maxon manual-reset valve shuts off flow of gas automatically and instantly upon any break in the electric power or safety circuit. Catalogs and engineering data sheets available.

CIRCLE (14) ON THE REPLY CARD

Improved design of North American Mfg. Co.'s roof section burner assures faster mixing resulting in greatly reduced stingers and higher efficiency. A flatter flame pattern, with adjustable flame shape, permits lowering of roof closer to work without getting excessive flame impingement, assures more uniform heat, and consequently a higher production rate. Available in air pipe sizes of 1¼ to 4-in. Air pressure of 16 osi produces range of 234,000 to 2,620,000 Btu per hour.

CIRCLE (15) ON THE REPLY CARD

1960 MERCOID CONTROL CATALOG lists mercury switch equipped controls for single stage pressure, 2-stage pressure, differential pressure, single-stage temperature, 2-stage temperature, liquid level and mechanical movement. Also illustrated in the 56-page catalog are transformer-relays and Mercoid's line of hermetically sealed mercury switches.

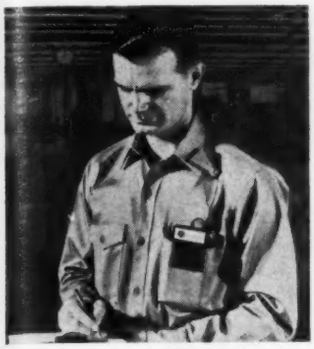
CIRCLE (16) ON THE REPLY CARD

The MINIATURIZED-PRECISION WILKINSON Line Locator Model W-3

This radically new, super-powered, transistorized instrument weighs only four pounds and is one-fourth the size of conventional pipe locators.

**It is as handy as a flashlight;
the maintenance is trivial;
the non-leak miniature batteries last ten times longer. Long-life transistors eliminate replacement. Molded glass fibre cases. Transistor ear set. Telescopic handle. Etches circuitry and unique antenna. Contained in carrying case.**

WILKINSON PRODUCTS COMPANY
3987 Chevy Chase Drive • Pasadena 3, California • SYlvan 0-4314



All-transistorized shirt-pocket personal radio communications receiver with miniaturized circuitry, just introduced by General Electric Co., boosts audio efficiency and requires 35 percent less battery power than previous hand-carried message equipment of its type. New unit weighs only 12 oz with battery, is so engineered that the person wearing it may be contacted instantly by a base station transmitter, a 2-way radio in a car, or by a portable unit operating on the same frequency. Initially, frequencies in the 150-174 mc range will be used.

CIRCLE (17) ON THE REPLY CARD

Sealed "Safti-Vent" gas heater that installs in a window is now available from H. C. Little Burner Co. Installation and removal is comparable to any air conditioner. Unit is completely factory-assembled; operates with sealed burner in which gas flame and pilot burn in a chamber completely sealed away from room air. Built-in vent admits oxygen from outdoors and releases products of combustion directly outdoors. Has 20,000 Btu capacity.

CIRCLE (18) ON THE REPLY CARD

IRON FIREMAN'S complete line of commercial and industrial fuel burning and auxiliary equipment and a helpful "Index and Selection Chart" that simplifies selection of appropriate equipment for any application are described in new 12-page, illustrated catalog. Comprehensive catalog covers the entire Iron Fireman commercial-industrial line of gas burners, dual fuel burners for gas and oil, forced draft package units, boiler-burner units, coal stokers, factory wired combustion control panels and the Iron Fireman SlecTemp steam heating system.

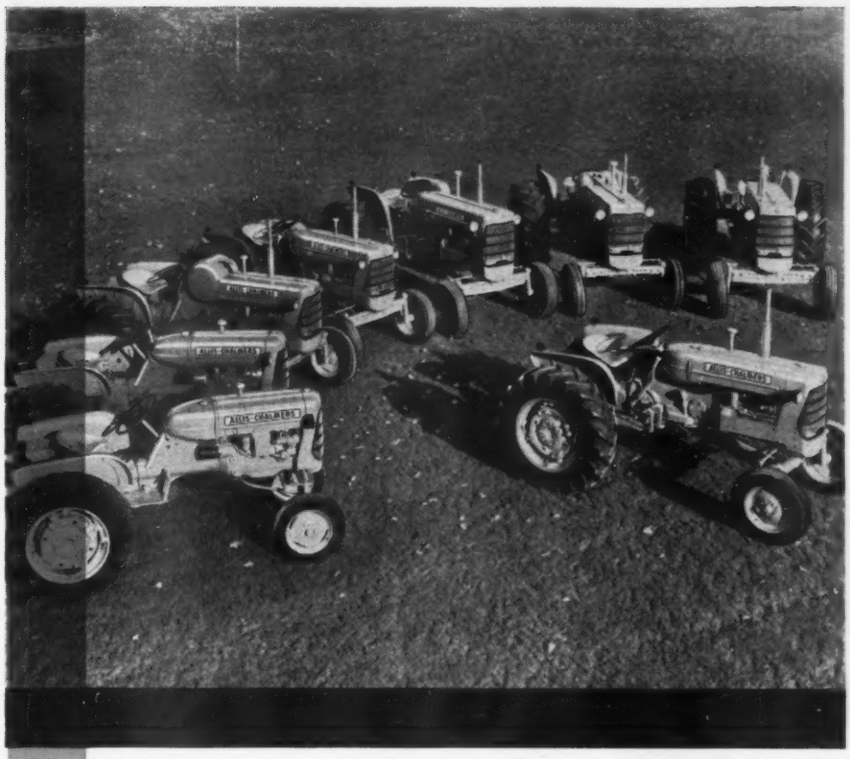
CIRCLE (19) ON THE REPLY CARD

PERSONNEL FILE FOLDERS that incorporate a standard employment application on the inside and back of the folder are now available from Aptitests. Printed in two colors and on special file folder index stock for extra durability, the new file folder keeps all of the employee's records neatly in one place. Standard employment application includes fill-in blanks for personal information, references, specific job information, military experience, education and training and past employment record.

CIRCLE (20) ON THE REPLY CARD

Time and money-saving tips on how to achieve efficiency in all phases of shipping and warehousing are included in a new booklet entiled "100 Ways to Save Money in Packing, Shipping, and Stockroom Operations," prepared by Manpower, Inc.

CIRCLE (21) ON THE REPLY CARD



It doesn't cost to find out
which one fits your need!

With Allis-Chalmers utility tractors, you choose the power and weight you want, choose the equipment that does your job best.

The D-17 is the heavyweight; powered with diesel, gasoline or LP-gas. It puts 5,300 lb of tractor to work over a long wheel base that *still* lets you maneuver tight.

The D-14 is the most popular work horse. With SHUTTLE Clutch, it's ideal for quick forward and reversing jobs.

D-10 and D-12 are the smallest—they'll surprise the man that expects junior-size performance.

Get the facts on the utility tractors with the most practical engineering in the field—Allis-Chalmers. Use the coupon below.

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Utility tractors from 34 to 63 engine horsepower with companion equipment to match your needs!

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ALLIS-CHALMERS MFG. CO
Utility Tractors & Equipment, Milwaukee 1, Wisconsin

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SOLD BY ALLIS-CHALMERS DEALERS EVERYWHERE

Numerous improvements have been made in Hough's H-70 and H-90 "Payloader" four-wheel-drive tractor-shovels to increase production and better the performance. While operating capacity of the H-90 remains at 9000 lb, peak lift has been increased to 18,000 lb; unit has a longer wheelbase and wider tread to provide better balance and greater stability. Additional power is provided by new Cummins turbo-charged diesel engine. The H-70 unit retains same operating capacity of 7000 lb, but its peak lift has been increased to 13,000 lb. Improvements in boom arm and bucket control linkage provide additional digging power, especially helpful for below grade work; larger Cummins diesel engine develops 124 hp.

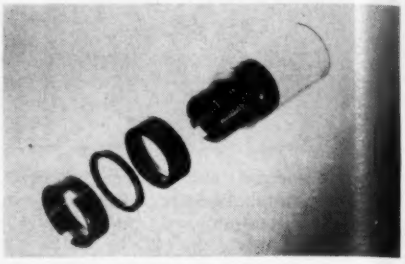
CIRCLE (22) ON THE REPLY CARD

INFRARED ANALYZER M-S-A (Model 300 LIRA) is described in a bulletin just issued by Mine Safety Appliances Company. Specially designed features of the new instrument, including its small size and portability, roll-out tray construction, and flexibility in handling a variety of gas analysis problems are described. Applications including detection of toxic and combustible gases are briefly outlined.

CIRCLE (23) ON THE REPLY CARD

New truck-mounted backhoe offers full ⅜-yard struck capacity. Heaped loads of ½-yard or more are said to be "the rule rather than the exception" under actual job conditions, in both light and heavy materials. Making this added capacity possible are a 1500 psi hydraulic system with 5¼-in. ID cylinders throughout, a 180 deg wristing action at bucket, and a counter-weighted truck front-end for added stability. Backhoe can be mounted on any new or used 2-ton truck, either factory-mounted or locally mounted on buyer's own truck.

CIRCLE (24) ON THE REPLY CARD



Service head adapter consisting of a 3-in. length of transparent butyrate plastic tubing sealed to a threaded metal sleeve simplifies connection of butyrate gas service renewal to metal house piping. Natural rubber gasket expands under pressure from a metal collar to the diameter of the old metal service line and prevents back-flow of gas when the metal house line and fittings are replaced. Plastic end of the adapter is solvent-welded to the butyrate renewal at the service head, after the tubing has been inserted in the corroded metal service line.

CIRCLE (25) ON THE REPLY CARD

DAVEY COMPRESSOR COMPANY'S Model 600 RP Hydrovane rotary compressor is described in a new 4-page bulletin. Specifications, action photos, and a list of exclusive design features such as the patented, long life Perma-Vane rotor blades said to eliminate blade deterioration and breakage, are included in the bulletin. The rotary compressor delivers 625 cu ft per minute at 100 psi; the 4-wheel trailer is 11 ft 9 in. long, 7 ft 8 in. high and 6 ft 7 in. wide and weighs 8800 lb.

CIRCLE (26) ON THE REPLY CARD

ILLUSTRATED INDEX of the finishing systems — from spray guns to complete systems — available from The DeVilbiss Co. has just been released. All equipment items needed for a fully integrated finishing installation including spray guns, automatic spray coaters, flow and dip coaters, industrial ovens, air compressors, dust collectors, spray booths, industrial power washers, hot spray systems, paint tanks and pumps, and phosphatizing systems are described in the 4-page bulletin. DeVilbiss maintains a customer research laboratory to work out finishing problems, perfect and thoroughly test systems in advance in cooperation with customers, engineers and finishing personnel.

CIRCLE (27) ON THE REPLY CARD

THE MANUFACTURE OF SYNTHETIC RUBBER PARTS for Grove valves and regulators is described in new 2-color 4-page bulletin. Photographs illustrate the unique equipment that has been designed specifically to make the synthetic rubber parts such as diaphragms in the Grove Powereactor dome regulators, the expansion tubes in Grove Flexflo and Chexflow valves and the O-Rings in Grove Seal-O-Ring gate valves.

CIRCLE (28) ON THE REPLY CARD

NEW IN PRINCIPLE!
NEW IN DESIGN!

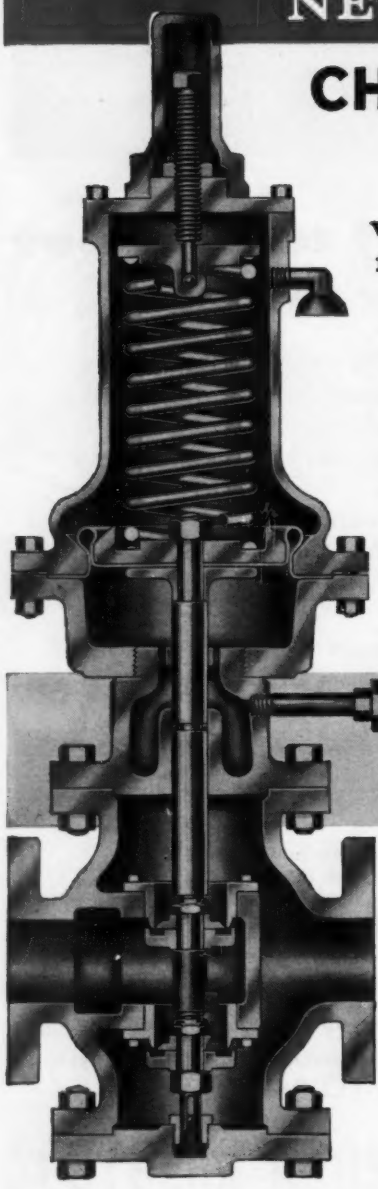
CHAPLIN-FULTON

Model 57-S

GAS REGULATOR

with "ROLL-OUT" Diaphragm

for constant pressure control

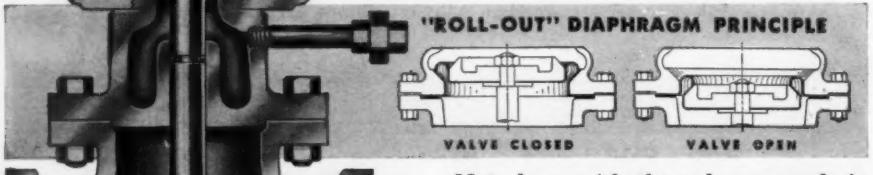


Chaplin-Fulton Model 57-S is a simple spring loaded regulator which performs like a pilot loaded regulator, without the added complications. For pounds-to-pounds service—inlet pressures to 400 psi—controlled pressures to 75 psi, with deviation through full valve travel less than 1 psi.

NO "FALL-OFF" AS FLOW INCREASES

The drooping characteristics or outlet pressure "fall-off," typical of conventional spring regulators, is eliminated—not by using an uncontrollable velocity effect—but by a new diaphragm design which actually reverses the action of a conventional diaphragm. It changes its area as the valve opens to compensate for the loss in spring loading force.

"ROLL-OUT" DIAPHRAGM PRINCIPLE



Note how, with the valve upwards in the closed position, the diaphragm achieves its maximum effective area—and decreases as the valve opens. The area changes at the same rate as the spring loses compression, to give a constant controlled pressure—determined entirely by valve movement.

2" - 3" - 4" - 6"

Write for Bulletin 57-S

ACCURATE CP DEPENDABLE

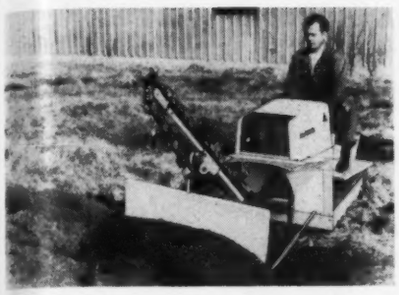
MFG CO

Chaplin-Fulton

MANUFACTURING COMPANY

Pittsburgh 33, Pennsylvania

PARADE



Trencher that handles its own backfilling assignments is the 1960 Davis T-66 trencher. Backfill blade can be raised or lowered hydraulically, and set straight or angled to the left by a simple pin setting. Only 37-in. wide, unit passes easily through yard gates. With telescoping attachment can dig to 66-in. depths in 3 to 4-in. widths; weighs only 1350 lb.

CIRCLE (29) ON THE REPLY CARD

Fire-retardant paint and how it is applied in all types of industrial, commercial and institutional buildings to improve safety and reduce potential fire damage is subject of a new 12-page illustrated bulletin, "Paint Your Way to Fire Safety," published by Albi Manufacturing Co., Inc.

CIRCLE (30) ON THE REPLY CARD

How microfilm is used in preparing engineering drawings for world-wide distribution is explained in an 8-page illustrated manual, available from The Filmsort Co. Manual describes how the U. S. Army Signal Corps converts engineering drawings and data to microfilm mounted in aperture cards thereby sharply reducing its logistical and filing problems; is of interest to users of office machine equipment and systems supervisors responsible for speedy filing and recall of data.

CIRCLE (31) ON THE REPLY CARD

Study on auto fleet leasing recently revised and published by Foundation for Management Research tells when companies should lease or own their autos. Entitled, "Advantages and Disadvantages of Auto Fleet Leasing: A Comparison of Company Ownership, Salesman Ownership, and Leasing," the 28-page study points out that leasing of auto fleets by industry is gaining ground rapidly. Five tables and charts analyze fixed and variable costs at different mileages and disclose effects of different plans on company earnings.

CIRCLE (32) ON THE REPLY CARD

Engineering data bulletin of interest to industrial gas utilization engineers on basic flame spray processes for coatings of metals, ceramics, carbides and other high-melting-point materials has just been published by Metallizing Engineering Co., Inc. The 16-page bulletin covers the metallizing process, which utilizes metal in wire form; the thermospray process, which sprays metals and other materials in powdered form including alloys of nickel-chromium-boron-silicon, and ceramics such as alumina and zirconia; and the new plasma flame spray process, which develops temperatures up to 30,000 F and sprays any material that can be melted without decomposition.

CIRCLE (33) ON THE REPLY CARD

Operation of unique combination hydronic heating and cooling packaged system for motels is described in new 17 by 22-in. illustrated sheet from Edwards Engineering Corp. The system, trade-named "Zone-A-Matic," provides individually zoned hot water baseboard heat, zoned convection cooling, and ample domestic hot water. Sheet illustrates and describes heating layout for typical motel, heating system electrical wiring, cooling system electrical wiring, and schematic piping layout for heating and cooling each motel unit.

CIRCLE (34) ON THE REPLY CARD

Tough, flexible epoxy coating, developed by Carl Biggs Co. after years of research and in-soil testing, protects metal pipe against abrasion and corrosion from water, soil acids, etc. First coat is applied to clean dry pipe and a gas jet is sometimes used to heat pipe to offset cold weather which makes the epoxy coating harder to brush on. After 12 hours curing at average temperature of 70 F, coating is hard enough to test with electrical "jeep" to spot pinholes. One coating builds up approximately 1/64-in.; 2 coats 1/32-in.

CIRCLE (35) ON THE REPLY CARD

SIMPLIFIED METHOD for figuring correct wrench size for any bolt or nut diameter is included in Lowell Wrench Company's new catalog. Complete line of reversible ratchet wrenches, including all new ½-in. square drive socket sets, available in the revolutionary 10-point and the conventional 12-point sizes are described.

CIRCLE (36) ON THE REPLY CARD

Lancaster

non-crack SYNTHETIC DIAPHRAGMS

improve gas meter accuracies without changing index gear ratios . . . without fabric failure

Gas meters operate at regular speed with Lancaster diaphragms S-7-L (and S-70-L with new adjustable height side carrier and oval-slot center bracket) for 1-A, #240 and Beta gas meters!

You increase meter accuracy without increasing meter wear. There's no cloth lining to cause fabric failure . . . no need to change standard meter parts . . . no need to hurry up meter wear.

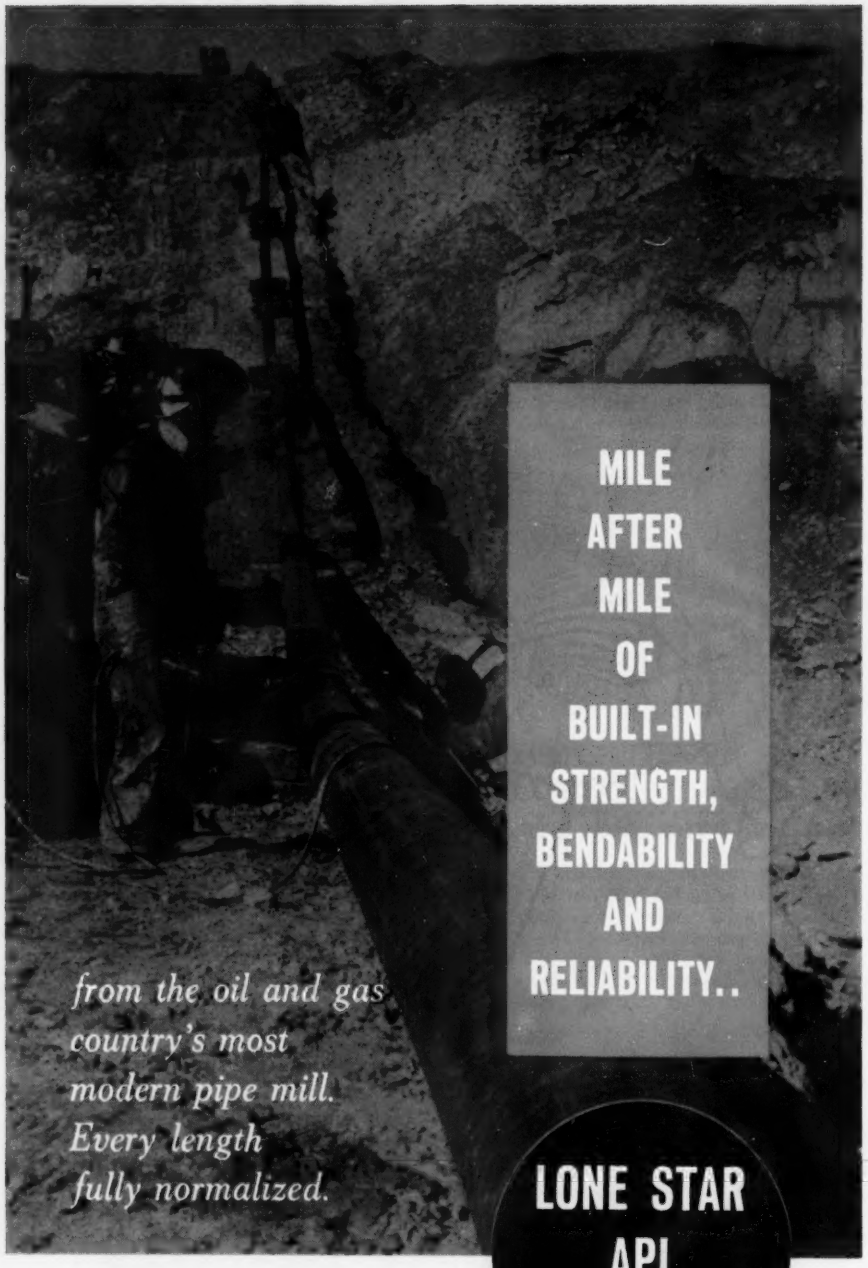
Actual service and laboratory tests have proved the high flexibility low differential and superior performance. Order Lancaster Synthetic Diaphragms.

Lancaster
METER PARTS CO.
POST OFFICE BOX 378, LANCASTER, OHIO

Catalog No.	Sprague
S-70-L	1-A
S-70-L-240	240
S-7-L	1-A
S-7-L-240	240

Other Lancaster Synthetic Diaphragms	
C-1-L	#1 Ironclad
O-L	#0 Emco
1-L	#1 Emco

See catalog for complete line of leather diaphragms

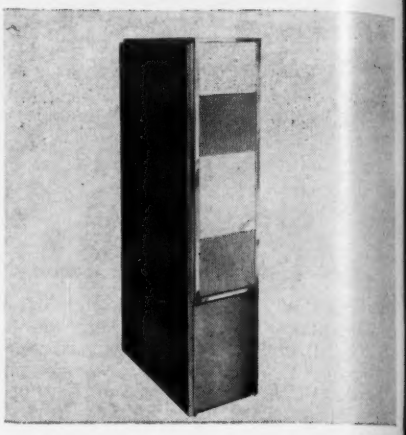


Joe Roughneck's Pipe Mill

Lone Star STEEL
COMPANY

EXECUTIVE—SALES OFFICES
W. Mockingbird Lane at Roper • P. O. Box 12226 • Dallas, Texas
DISTRICT SALES OFFICES
912 Republic National Bank Building, Dallas, Texas
Houston, Texas | Midland, Texas | Tulsa, Oklahoma

PRODUCT PARADE



COMPACT LINE OF GAS-FIRED UP-FLOW FURNACES have been added to Armstrong Furnace Co.'s warm air heating and air conditioning equipment. New units, designated the 700 series, are available in 60,000, 80,000, 100,000 and 120,000 Btu capacities. Are A.G.A. approved for installation with 0-in. clearance on the back, both sides and bottom. Cabinets on the 60 and 80,000 Btu models are 25½ deep, by 12-in. wide and 54-in. high; the 100 and 120,000 Btu models have the same height and depth but are 20-in. wide. Improved diverter design has made it possible to design an approved 4-in. flue pipe for the 60 and 80,000 Btu per hr capacity furnaces and 5-in. flue pipe for the 100 and 120,000 Btu per hr capacity furnaces. The small 4-in. flue pipe dimension is an Armstrong first in the industry.

CIRCLE (37) ON THE REPLY CARD

INTERNATIONAL HARVESTER construction equipment is depicted in brief form, in a new 24-page, 4-color folder. Included are crawler tractors in 6 power classes, 5 Payscraper and Paywagon units, 2 Payhauler models, 5 International Drott Four-in-One rigs and 4 International Superior sidebooms. Also shown are 16 hydraulic and cable dozer and grader blades, 2 tractor-drawn scrapers, 4 cable control units, 5 push plates and 24 diesel and carbureted International engines.

CIRCLE (38) ON THE REPLY CARD

Results of 8-year corrosion tests conducted by the U. S. Naval Research Laboratory on wrought iron and 10 structural steels in salt water and lake water environments are contained in a 12-page report available from A. M. Byers Co. Comparative corrosion-time curves, weight loss tables, and a detailed discussion of test materials, conditions, methods, and results are included in the report.

CIRCLE (39) ON THE REPLY CARD

CATERPILLAR NATURAL GAS ENGINES BOOKLET traces development of the natural gas engine, shows model views, specifications, and fuel consumption curves of current models and explains why these engines offer such low cost per horsepower. The 8-page booklet includes photographs and job stories illustrating varied applications of engines in irrigation, gas compressor, pipeline, air conditioning, gas separation, and other installations.

CIRCLE (40) ON THE REPLY CARD